



STATE OF NORTH CAROLINA  
UNDERGRADUATE RESEARCH & CREATIVITY SYMPOSIUM

# ***SNCURCS*** ***2020***

***Saturday, November 7***





*State of North Carolina  
Office of the Governor*

*Roy Cooper  
Governor*

*20301 Mail Service Center  
Raleigh, N.C. 27699-0301*

November 7, 2020

Dear Friends:

As Governor, I am delighted to welcome you all to the 16<sup>th</sup> Annual State of North Carolina Undergraduate Research and Creativity Symposium. Even with the unprecedented times we are experiencing, I know everyone is excited to have an opportunity to participate.

I sincerely appreciate the hard work done by East Carolina University and Elizabeth City State University to make available this opportunity for undergraduate students to make presentations in their chosen fields. Our university and college students have a wealth of talent and I am proud of their efforts.

My best wishes to all of the participants and others involved in this exciting event.

With kind regards, I am

Very truly yours,

A handwritten signature in black ink that reads "Roy Cooper". The signature is fluid and cursive, with the first letters of "Roy" and "Cooper" being capitalized and prominent.

Roy Cooper

RAC/sm

*Location: The State Capitol Building, Raleigh, N.C. 27602  
Phone: 919-814-2100*



November 7, 2020

Dear Undergraduate Researchers, Faculty, and Guests:

On behalf of the entire East Carolina University (ECU) community, I am delighted to welcome you to the 2020 (virtual) North Carolina Undergraduate Research and Creativity Symposium. ECU is committed to our mission to be a national model for student success, public service and regional transformation. We also know that this form of student engagement, undergraduate research, plays an important role in promoting student success. Engaged students are successful students!

ECU is proud to host this year's symposium in partnership with Elizabeth City State University. This symposium recognizes the inquiry-based scholarship conducted by undergraduates throughout North Carolina and celebrates the dedication of mentors from higher education, industry, and government. We are pleased to provide this opportunity where diverse students can meet and learn from each other. Our hope is that this symposium will help to inspire and prepare the next generation of students to be critical thinkers, problem solvers, and collaborative members for our communities.

I want to thank the sponsors, faculty mentors, staff, and the many volunteers who have made this academic experience available to our students. Your dedication and support of our students will help to yield life-long learners and engaged citizens.

Sincerely,

A handwritten signature in cursive script that reads "Ron Mitchelson".

Ron Mitchelson  
Interim Chancellor



November 7, 2020

Greetings,

On behalf of the Elizabeth City State University faculty, staff, and students, I am delighted to welcome you to the 2020 State of North Carolina Undergraduate Research and Creativity Symposium. It is an honor to co-host this year's event with one of the University of North Carolina System Schools, East Carolina University.

We are all excited to join and support our students as they showcase their research and creative work through posters, presentations, exhibits or performances. I believe the works that will be presented today foreshadow groundbreaking research and cutting-edge creative presentations that will change the way our very world operates.

While we remain in a "virtual" world, I am certain that this symposium will be informative, enlightening, and will engage brilliant minds, tapping into creativity and a research focus.

Thank you to our faculty and the mentors who provide our students with educational guidance, platform, and inspiration necessary to bring to life their research and creative works.

We applaud each mentor/supporter, their efforts and celebrate each student who has put forth a submission for this symposium. May this be the continuation of academic and creative success.

Sincerely,

A handwritten signature in black ink, appearing to read "Karrie G. Dixon".

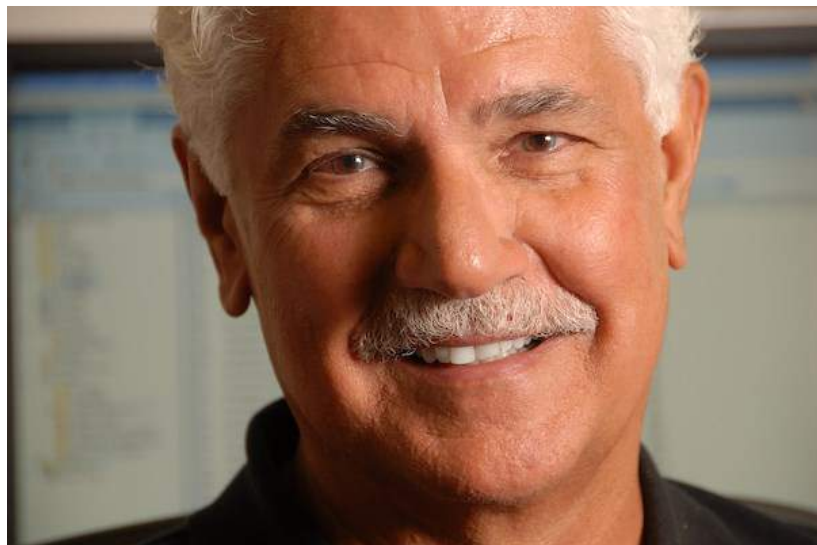
Karrie G. Dixon, Ed.D.  
Chancellor

**Office of the Chancellor**  
1704 Weeksville Rd. Elizabeth City, NC 27909

p: 252. 335. 3228 | f: 252. 335. 3542 | [www.ecsu.edu](http://www.ecsu.edu)

*ECSU is a constituent institution of the University of North Carolina System.*

## George Barthalmus Undergraduate Research Awards 2020 - 2021



Dr. George T. Barthalmus (1942-2011) was the driving force behind the creation of the State of North Carolina Undergraduate Research and Creativity Symposium. He had a passion for encouraging undergraduates to pursue their interests through the process of research, be it in the sciences, humanities, or through artistic expression. He was an advocate for early involvement of students in the research process as a way to engage and retain students in academics. To this end, the George Barthalmus Undergraduate Research Awards have been developed to promote early

involvement in the research process through support of sophomores in a research project of their design.

These awards are designed to assist students with development and engagement in undergraduate research. Students from all disciplines are invited to apply for the awards. The winners of the grant will present their research at the next Annual SNCURCS event in 2021.

### Award Recipients

The following students received the 2020-2021 George Barthalmus Undergraduate Research Award:

<u>Name</u>	<u>Institution</u>	<u>Discipline</u>
Katherine Day	NC State University	Chemical Engineering
Elizabeth Gross	NC State University	Chemistry
Sarah Grubich	NC State University,	Sports Management
Abigail Korenek	NC State University	Microbiology
Anna Williams	East Carolina University	Molecular Biology

# **Oral Presentations**

## **By Disciplines**

Arts, Design, and Performing Arts  
Biological & Life Sciences  
Business & Economics  
Chemical Sciences  
Communication & Journalism  
Computational Sciences  
Cultural & Language Studies  
Education  
Engineering  
Environmental Sciences  
Humanities  
Mathematics & Quantitative Studies  
Medical & Health Sciences  
Physical Sciences & Astronomy  
Social & Behavioral Sciences

# **Poster Presentations**

## **By Disciplines**

Arts, Design, and Performing Arts

Biological & Life Sciences

Business & Economics

Chemical Sciences

Communication & Journalism

Computational Sciences

Cultural & Language Studies

Education

Engineering

Environmental Sciences

Humanities

Mathematics & Quantitative Studies

Medical & Health Sciences

Physical Sciences & Astronomy

Social & Behavioral Sciences

# Oral Presentations

## Arts, Design, and Performing Arts

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**Student Authors (s):** Rekeibe, Sophia; UNC Chapel Hill

**Mentors (s):** Figueroa, Michael; UNC Chapel Hill

### **Haydar on the Radar: Resisting Orientalism and Global Patriarchy through Hip Hop**

The study of Arab hip hop is an emerging field of study within ethnomusicology and Middle Eastern studies alike. Many of these artists, like Omar Offendum and Narcy, address issues faced by Arabs and Muslims such as xenophobia, Islamophobia, and racism. Overall much of today's popular cultural content pertaining to Muslim and Arab Americans are centered on male narratives. These artists have narratives of their own, but they lack a feminist lens for addressing Muslim and Arab American women. Writings such as Arab-American Women's Writing and Performance: Orientalism, Race and the Idea of the Arabian Nights and Scheherazade's Legacy: Arab and Arab American Women on Writing articulate the experiences, writings, and performances of Arab and Muslim women. This project aims to explore how Muslim Arab American rapper Mona Haydar resists Orientalist ideology through her musical content and imagery by challenging the listener's perspective and reaffirming the experiences of her audience of Muslim and Arab American women. I examine three of her songs, analyzing her lyrics and music videos to better understand how Haydar positions her music within a broader discourse of Muslim and Arab American writers, performers, and musicians. I argue that Mona Haydar is intervening in Western Orientalism and global patriarchy as a way to reclaim her Arab and Muslim identity and assert her personhood in a context where it is under constant surveillance and threat.

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**Student Authors (s):** Gomez, Emily; Elon University

**Mentors (s):** Aumiller, Renay; Elon University

### **Cuerpo Talk: Expressions of LatinX Identity through Choreography**

Cuerpo Talk: Expressions of LatinX Identity through Choreography is an analysis of LatinX contemporary choreographers through the lens of transnational migration theories and Laban Movement Analysis. The research will compare two prominent LatinX identities in the American dance community, Rosie Herrera and Miguel Gutierrez, and how they express their transnational identities through their performance art. Through the use of Laban Movement Analysis, this study has discovered American contemporary dance forms underrepresent LatinX people and their cultural dances often incorporated within American contemporary dance. Both Herrera and Gutierrez use Hispanic music, movement, and storytelling in order to convey their ethnic identities within their work. By analyzing their choreography through transnational migration theories, this research aims to highlight the impact of cultural adaptation and repression of ethnic expression.

**Student Authors (s):** Birtchet, Bailey; Meredith College

**Mentors (s):** Benko, Steven; Meredith College

### **America's Problem of Authenticity: A Material Culture Approach to Ethical Design and Consumption**

Graphic design is the process of visual communication through imagery and typography. Because it is a culturally specific practice, it influences everyday lives by reflecting the different aesthetic and moral priorities of the culture in which it is practiced. In the United States, graphic design creates the desire to purchase and connect one's identity to a consumer product. The result has been that the design, production, and consumption of advertisements for material goods simultaneously reinforces and perpetuates societal moral concerns and priorities, like consumerism, as much as it reflects them. At the same time, consumerism has a negative impact on the environment and causes existential inauthenticity. By understanding the link between U.S. graphic design and consumerism, graphic designers in the U.S. can create new narratives that insert concern for the environment and authentic self expression both in the design process and in the consumption of the design. Using theories of material culture and the writings of de Certeau and Bourdieu, this project reframes design as a tactical practice meant to counter hegemonic consumerist norms. By explaining how design operates within society through examples drawn from U.S. culture, this presentation will demonstrate how consumerist values—competition, consumption, and wealth—have become embedded in U.S. graphic design. This presentation will include designs that demonstrate concerns for the environment and the community as a way to develop a more sustainable design practice.

**Student Authors (s):** Hunter Jr, Otis; Chowan University

**Mentors (s):** Hayes, Tim; Chowan University

### **WHY DO WE RIOT?**

Why Do We Riot is a societal response to negative stigmatism that is related to riots. This piece was written in the wake of the incident with George Floyd and the race riots that followed after it. I wrote this to exhibit how rioting is a last resort for Black people in America who repeatedly see justice not being served for actions that are clearly criminal. Peaceful protests have been done, and we have been shut down for it. Even though rioting is not the best means of getting our voice heard, it is a viable option when we run out of methods that strive for the equality we deserve. It is a lose-lose situation. If we do riot, we get recognized but only for the violence being portrayed instead of what caused us to riot in the first place. If we don't riot, it is like shrugging our shoulders at the inevitable. The bottom line is we need to acknowledge that all lives should be treated equally. People of color in America should not have to deal with more problems for being born in what is considered "the wrong skin". This is America. Land of the free. Home of the brave. There is no reason we should still be slaves to discrimination.

# Oral Presentations

## Biological & Life Sciences

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**Student Authors (s):** Patel, Viha; North Carolina School of Science And Math

**Mentors (s):** Sheck, Amy; North Carolina School of Science And Math

### **The Use of Saponin and Cinnamaldehyde to Decrease Total Body Glucose and/or Body Weight of *Drosophila melanogaster* with Type II Diabetes mellitus**

he global Type II Diabetes mellitus prevalence in 2019 was estimated to be 9.3% (463 million people), rising to 10.9% (700 million) by 2045. While effective treatments for diabetes exist, they require the maintenance of a healthy lifestyle necessary to be optimized. For individuals who have physical disabilities or other conditions that prevent sufficient exercise and diet modification, there is opportunity for phytochemicals to play a profound role in treatment. Peroxisome Proliferator-Activated Receptors (PPARs) are a family of ligand-activated transcription factors that regulate the expression of genes involved in metabolic and anti-inflammatory processes. Saponin, a phytochemical, has been shown to activate PPAR $\alpha$ . Cinnamaldehyde, another phytochemical, has been shown to stimulate PPAR $\alpha$  and PPAR $\gamma$ . As the compounds act on different PPARs, using them in conjunction may achieve increased efficiency. In preliminary studies, *Drosophila melanogaster* reared on a High Sugar Diet (HSD) did not display significantly higher weight than those reared on a Normal Diet. As a response, this experiment utilized the *Drosophila melanogaster* strain chico, which exhibits insulin receptor binding activity and is used to study type II diabetes, instead. To assess the effectiveness of Saponin and Cinnamaldehyde as potential supportive treatments for type II diabetes, wildtype and chico *Drosophila melanogaster* will be exposed to varying concentrations of each compound. The wet body weight and total body glucose of the *Drosophila melanogaster* will then be analyzed in an effort to conclude whether or not the compounds had any significant effects on two prominent markers of Type II Diabetes mellitus.

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**Student Authors (s):** Sortisio, Nick; North Carolina School of Science And Math

**Mentors (s):** Sheck, Amy; North Carolina School of Science And Math

### **Effects of Induced Nectar Composition by Acoustic Waves on Plant-Insect Interaction**

Sound has become an increasingly studied plant stimulus, and recent work has demonstrated that certain plants augment carbon investment in nectar production in response to the sound of pollinating bees. In order to better understand the evolutionary context of such an adaptation, this work draws on the extant optimal foraging literature to develop a game theoretic, plant-centric model of plant-pollinator interaction that describes induced nectar quality as a non-antagonistic, cost-mitigating strategy lying outside the typical mutualist-antagonist paradigm. Initial modeling of selection without induced alteration of nectar composition as an available phenotype is found to match observed patterns of low nectar investment in the wild when bees are allowed to vary the extent to which they discriminate based on signals of nectar quality (i.e. selectors or non-selectors). When added to the model, the inducible phenotype becomes an important modality for the avoidance of costly nectar production while limiting loss of insect visitation associated with sustaining low nectar volumes and qualities. This framework allows for the incorporation of important features of insect foraging, including the effects of learning, selection, and nectar robbery. Co-evolution of mechanoreceptive nectar response and floral morphology is discussed, and the compatibilities of floral nectaries (FNs) and extrafloral nectaries (EFNs) with this model are compared. These results suggest that such a mechanism, whether arising through evolution—as it has in some cases—or through bioengineering presents a promising means of improving plant fitness, including in agricultural settings.

**Student Authors (s):** Britt, Benjamin; Brown, Robert; Yang, Tsuehai; Campbell University

**Mentors (s):** You, Take; Campbell University

### **Cloning And Expression Of Human Carbonic Anhydrase II In E. coli For Development Of A Therapeutic Drug**

Carbonic anhydrase is an enzyme with a zinc cofactor that catalyzes the rapid interconversion of carbon dioxide to bicarbonate and a proton. The structure and function of carbonic anhydrases are conserved throughout all living organisms. The Carbonic anhydrase from *Neisseria gonorrhea* has been cloned and expressed previously. Carbonic anhydrase from *N. gonorrhea* and most bacterial carbonic anhydrases are functional dimers. Most human carbonic anhydrases, on the other hand, are functional monomers. By exploiting this structural difference, we hope to develop small molecule inhibitors that are active against bacterial carbonic anhydrase dimers, but not active against the human carbonic anhydrase monomers. These inhibitors have the potential to be a new class of antibiotics. The first step in this process is to develop an in vitro assay that can screen molecules for inhibition of *N. gonorrhea* Carbonic anhydrase vs. human Carbonic anhydrase 2 (hCA2). As the next step in developing this assay, hCA2 cDNA was cloned into bacterial plasmid pET21c and the expression was conducted in *E. coli* BL21DE3. Time course protein expression studies by induction with IPTG indicated that hCA2 enzyme was expressed successfully and efficiently in *E. coli*. Purification of the enzyme and enzyme activity assay are underway.

**Student Authors (s):** Byrum, Camryn; North Carolina School of Science And Math

**Mentors (s):** Smith, Natalie; UNC Chapel Hill

### **Modeling and Mutating Synthetic Leucine Zippers**

Leucine zippers are coiled-coil peptide domains that can be utilized as tools to link molecules or cells together through dimerization. Zipper pairs of higher binding affinity outcompete binding between lower affinity pairs and allow for controllable and interchangeable systems. Such systems are being developed as therapies for cancerous tumors, myocardial infarctions, and burns. In a previous study we investigated the role of Interfacial Contacts (ICs) of residues on binding affinity by using protein modeling and docking prediction software to identify the K<sub>d</sub> values (inversely related to affinity) and specific ICs involved in pairs SYNzip2/SYNzip17 and SYNzip2/SYNzip22. This revealed the impact of ICs and Noninteracting Surface residues (NIS) on predicted binding affinity. Currently, the highest affinity synthetic zipper pair is SYNzip1/SYNzip2. A zipper pair with affinity to surpass SYNzip1/SYNzip2 is desired to increase efficiency of zipper treatments. We intend to investigate the relationship between SYNzip1/SYNzip2 by utilizing I-TASSER, CPORT+HADDOCK, and PRODIGY to predictively model the 3D structure of the peptides, peptide/peptide interactions, and K<sub>d</sub> & ICs respectively. Then, we will mutate SYNzip1 using ICs and NIS as a guide to optimize for increased affinity with SYNzip2. We expect that by using this guide we will create a zipper whose affinity will surpass the base SYNzip1/SYNzip2 pairing, and will outcompete it in competitive binding assays. Thus, we will expand the possible synthetic zipper affinity range, and develop an accurate modeling process which can guide future selection of mutated residues in zipper pairs.

**Student Authors (s):** Regidor Ranilla, Laura; Shaw University

**Mentors (s):** Butler, Eric; Shaw University

### **Antipredator Behavior in Predator-Naïve Amphipods**

Amphipods belong to the crustacean class Malacostraca and are found in a variety of habitats around the world. Prior research on the amphipod species *Gammarus minus* has shown that amphipods found in springs without fish have significantly different metabolic scaling slopes than amphipods in springs with fish predators (Glazier et al., 2011). In this study we wished to examine whether amphipods had also undergone changes in instinctive behavior in the absence of fish predators. Amphipods should respond to fish, or their scent, by hiding. We examined the amount of exposed activity (e.g., not under shelter) for amphipods from a fishless spring when the water they were swimming in was either from a fish tank with fish in it or from an empty tank. The second part of the experiment, which is still to be performed, will be based on experimental trials on amphipods from a spring with the presence of predators, to observe and record data, being able to identify any major changes in the results obtained for anti-predator behavior between both offspring (fishless and amphipods from the predator spring). The analysis and comparison of both data should solve the discussion of how the environment affects the evolution of the same species and if it has any big impact on it, as it was already observed a change in the metabolic rate of the same species.

**Student Authors (s):** Aubuchon, Lindsey; Zevada, Sergio; Thomas, Jaime; UNC Wilmington

**Mentors (s):** Lee, Soon Goo; UNC Wilmington

### **Biochemical and Structural Characterization of UDP-glycosyltransferases (UGTs) in the Stevia Biosynthetic Pathway**

Diabetes is a dangerous and growing epidemic. Because of the 34.2 million cases of diabetes in the US and an estimated 88 million people with prediabetes, scientists are working diligently to find methods of combatting the disease. Diabetes as a whole, renders the body of the afflicted individual incapable or less capable of breaking down sugars, primarily in the form of glucose. For this reason, it is believed that the identification and effective harvesting of new, natural, non-calorie or low-calorie sugar alternatives could be the key to preventing or combatting diabetes. Steviol glycosides derived from the leaves of the tropical *Stevia rebaudiana* plant are one of the most promising options. However, in order to mass-produce these natural sweeteners in a timely and cost-effective manner, it is first necessary to fully understand how they are produced in the plant. For this project, we have identified multiple enzymes, known as UDP-glycotransferases (UGTs), in the production pathway of steviol glycosides. The goal was to determine the best crystallization conditions and solve the 3D structure of the proteins.

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**Student Authors (s):** Tuton, Jared; Almeida, Michael; Bahr, Ben; UNC Pembroke

**Mentors (s):** Farizatto, Karen; UNC Pembroke

**Selective integrin signaling plays a distinct role during organophosphate-induced synaptopathology in hippocampal explants**

Organophosphates affect the nervous system and account for the world's deadliest poisons. These toxins inhibit acetylcholinesterase which leads to cholinergic crises, seizures, and long-term neurological problems. Besides being used in warfare atrocities, organophosphates are still widely used as agricultural pesticides, thus a public health concern. In this follow-up study, hippocampal explants exposed to paraoxon were also found to exhibit unique synaptotoxicity associated with selective integrin dynamics. The observed decline in synaptic proteins were independent of overt neuronal pathology. Synaptotoxic profiles were evident in the dendritic zones of the CA1, CA3, and dentate subfields, and they corresponded with  $\beta 1$  integrin responses. Noting that integrins form a bridge in many types of cell-cell interactions, it is of interest the enhanced  $\beta 1$  integrin staining was only evident in the neuropil, with no induction of such staining found in the astrocyte-rich area extending from the paraoxon-treated tissue. The active conformation of  $\beta 1$  integrin was targeted to synapses in response to the exposure, co-localizing with prominently-stained, synapsin II-positive puncta, even though this synaptic labeling had an overall reduction across the full dendritic area examined. As previously suggested, the stochastic events of  $\beta 1$  integrin signaling may signify a compensatory pathway to explain the apparent protection of select synapses. These findings suggest that anticholinesterase toxins mediate distinct synaptic damage, and the integrin signaling pathway plays an important compensatory role. Synaptic compromise in the hippocampus can be detrimental to many brain functions and integrin-linked responses activated by toxic insults appear to govern the extent of the synaptotoxicity.

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**Student Authors (s):** Clark, Molly; Robinson, Allison; Wiles, Elizabeth; Campbell University

**Mentors (s):** You, Taek; Campbell University

**Testing Effectiveness of Non-Medical Disposable Masks in Daily Life by Biological Techniques**

The recent COVID-19 outbreak caused a shortage of personal protective equipment. Many citizens have resorted to wearing non-medical disposable face masks (blue masks). There have been reports and studies of the effectiveness of different types of masks since the global spread of COVID-19. Among tests previously conducted, optical imaging techniques have been used to test effectiveness of different masks and mask alternatives in suppressing the spread of respiratory droplets during regular speech. The N95 mask filters 95% of micro particles measured by air particle penetration. Efficiency of masks has been tested by the bacterial and viral filtration through physical flow of bacterial or viral aerosol. There have been no reports of testing the filtration efficiency of masks through biological means. In this study, we tested the efficiency of a popular generic brand blue mask by measuring bacterial counts penetrated under simulated daily life. The study indicated that more speech is associated with higher bacterial counts regardless of the number of hours worn. The bacteria that penetrated the blue masks are presumed to be of the oral microbiome. Identification of isolated bacteria from the oral microbiome are underway. This study suggests that non-medical generic masks do not suppress respiratory droplets from spreading from person to person effectively. Therefore, we recommend maintaining a social distance and changing masks as often as possible.

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**Student Authors (s):** Yang, Lixin; North Carolina School of Science And Math

**Mentors (s):** Monahan, Kimberly; North Carolina School of Science And Math

**The Effect of Small Molecules Jh-RE-06 and T2AA on Mutagenic Translesion Synthesis in *Arabidopsis thaliana***

Cancerous cells in the body lose most healthy DNA repair systems, forcing them to undergo translesion synthesis (TLS), a cellular alternate repair strategy. Because TLS often promotes further drug resistance and mutations, limiting successful chemotherapy treatment, the inhibition of TLS in cancerous cells poses a possible improvement to chemotherapeutics. In recent research, two novel small molecules have been shown to inhibit specific pathways of TLS: JH-RE-06 (Wojtaszek et. al, 2019), and T2AA (Inoue A, Kikuchi S, Hishiki A, et al, 2014). JH-RE-06 conceals the binding surface of the Rev1/Rev7 polymerase interaction on the Rev1 dependent pathway in vitro and prevents binding to inhibit TLS. On the Rev1 independent pathway, T2AA inhibits the binding between monoubiquitinated PCNA with the Pol  $\eta$  polymerase, effectively decreasing TLS rates. In this project, the possibility of a synergistic effect between both drugs in inhibiting both pathways of translesion synthesis is investigated. Model organism *Arabidopsis thaliana* seeds were exposed to UV rays to induce TLS. Once successful, 40 seeds were plated on Murashige and Skoog (MS) plates and allowed to germinate. Seedlings were then exposed to control, Jh-RE-06, T2AA, and Jh-RE-06+T2AA treatments. A root bending assay revealed significant differences in root angle and length in the individual Jh-RE-06 and T2AA treatments compared to the control, while the Jh-RE-06+T2AA treatment revealed a greater significant difference compared to individual drug treatments. The data ultimately suggests TLS reduction from individual Jh-RE-06 and T2AA treatments but a greater synergistic effect when combining both Jh-RE-06+T2AA.

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**Student Authors (s):** Turner, Solomon; Brevard College

**Mentors (s):** Maveety, Sarah; Brevard College

**The Effect of Invasive Plants on Soil Bacterial Communities on Brevard College Campus**

Exotic plants threaten the stability of native ecosystems through the development of positive feedback loops which facilitate invader success. Soil microbial communities in invaded soils respond to positive feedback loops through increased decomposition rates and nutrient pools. The objective of the present study was to determine if the invasive monocrops of Bamboo (*Phyllostachys* sp.), Ivy (*Hedra* sp.), and Grass (*Fescue* sp.) on the campus of Brevard College, NC, cause changes in the bacterial diversity of their invaded soils compared to native *Rhododendron* (*Rhododendron* sp.). Three methods were used to obtain a representation of the soil's biological and chemical profiles. Bacterial enumeration was employed to determine if culturable bacteria were present in soil samples. Soil nutrient tests were used to analyze the growing conditions beneath each plant and assess the potential for microbial activity. BIOLOG EcoPlate assays were used to obtain Community Level Physiological Profiles (CLPPs) of the metabolic diversity for each plant for a comparison of functional diversity. Each soil sample produced culturable bacteria on nutrient agar plates. *Rhododendron* sp. had the most acidic soil pH and *Phyllostachys* sp. had the highest cation exchange capacity; soil nutrient concentration was generally below target levels for each sample. There was no significant difference in Shannon Diversity among the four soil bacterial communities. We suggest that there was no significant difference between native and non-native soil samples because of the sampling regime; it is well documented that invasive plants alter the chemical and biological profile of soil communities.

**Student Authors (s): Shakthy, Esha; North Carolina School of Science And Math**

**Mentors (s): Bennett, Jonathan; North Carolina School of Science And Math**

### **The Effects of Weak Magnetic Fields on Stem Cell Regeneration**

As digital transformation continues to shape the world, it is imperative to understand the risks and benefits of the weak magnetic fields (WMFs) emitted by electronic gadgets around us. Limited studies have been conducted to understand the role of weak magnetic fields, which are less than 1mT. Hence, this research focuses on studying the effect of WMFs including both DC and AC currents on the rate of stem cell regeneration in planarians, which are well-known for their regenerative properties. The control group was set up at earth's geomagnetic field of 45 $\mu$ T while experimental groups included 30 $\mu$ T, 75 $\mu$ T, 150 $\mu$ T, 300 $\mu$ T, 450 $\mu$ T, 600 $\mu$ T in a DC setup and 30 $\mu$ T, 300  $\mu$ T, 600  $\mu$ T at both 5 and 60 Hz frequency in the AC setup. The results of the DC test indicate that lower magnitudes of WMFs (30 $\mu$ T to 75 $\mu$ T) follow a similar trend to that of the geomagnetic field, the midrange magnetic fields (150 $\mu$ T to 450  $\mu$ T) show a reduced growth, and the high magnitudes of magnetic fields (600  $\mu$ T) show an increased growth. The AC test results illustrate that the lower frequency at 5 Hz produces two peaks in percent growth, unlike the control group, while the higher frequency at 60 Hz resulted in one peak, similar to the control group. This study illustrates how specific magnetic field strengths can be used to accelerate or decelerate cellular mitotic rates, and is a stepping stone to explore potential developmental risks from WMFs as well as their application for new treatments and therapies.

**Student Authors (s): Shah, Esha; North Carolina School of Science And Math**

**Mentors (s): Brantley, Kelly; North Carolina School of Science And Math**

### **Variability of testing protocols and the impact of concussions on student athletes in Iredell Statesville Schools**

I observed whether different concussion testing protocols can affect an athlete's ability to return to play. This project started with research to understand the basics of sports-related concussions. Three high schools in Iredell-Statesville were chosen to evaluate testing protocols used on student-athletes. I contacted the Licensed Athletic Trainer (LAT) for School A, School B, and School C to obtain concussion data; the athlete's name, ID and age were kept confidential. Three different testing protocols were identified, SCAT3, Concussion Vital Signs and imPACT. Once these protocols were identified, research was conducted on each protocol. Data for student-athletes between 2017-19 was reviewed. School A had a total of 383 athletes who completed baseline imPACT testing. School B had 452 athletes who underwent baseline concussion vital signs testing. School C had 366 athletes who took the sideline assessment (SCAT3) if a concussion was sustained. Among all three schools, football reported having the highest concussion risk. Soccer at School A and School C had the second-highest concussion rates. The average amount of days it took a School A and School B athlete to return to play (RTP) was 23.3 days and a School C athlete only took 6.7 days to RTP. In conclusion, the results showed baseline neurocognitive assessment played a significant role in the football athletes ability to return to play. Results revealed football players took an average of two weeks longer to return to play than athletes who only completed a sideline assessment.

**Student Authors (s): Wenzel, James; North Carolina School of Science And Math**

**Mentors (s): Sheck, Amy; North Carolina School of Science And Math**

**The detrimental effects of soil-bound microplastic pollution on the earthworm, *Eisenia hortensis***

By the year 2050, approximately 12,000 megatons of plastic will be produced worldwide with 79% of it finding its way to landfills or the environment. As plastic exists in the natural world solar degradation and environmental stressors cause it to degrade eventually becoming a microplastic (particle 5mm). These particles are extremely ubiquitous and have been in every biome, however they have rarely been studied in terrestrial ecosystems. This project looks at the interaction of these microplastics particles varying in size, concentration, and chemical composition with the earthworm, *Eisenia hortensis*. Worms were exposed to microplastics introduced to the surface of the soil varying in size (100-600µm, 600-2000µm, 2000-5000µm), concentration (1, 5, 9 g/500 mL soil), and composition (Polyethylene, Polypropylene, Polystyrene). Measurement of growth rate, mortality, and digestive behavior through cast composition showcase the full toxic nature of the microplastic particles. While the effect on worm mortality was negligible, the growth rate of exposed organisms was significantly reduced. Medial pollution levels (5g/500ml of soil) of the 600-2000µm size class were shown to have the most severe effects. Additionally more brittle plastics particles like polystyrene and polypropylene were shown to reduce the growth rate by approximately 10 and 8 percent respectively as well as produce blockages in the worm's digestive track. *Eisenia hortensis* are epigeic worms used often in agricultural settings to maintain soil quality, the perfect medium for the plastics found in products like insulation tarps, produce packaging, stem and branch management etc. to seriously damage the ecosystem.

**Student Authors (s): White, Malia; Fayetteville State University**

**Mentors (s): Graham, Justin; Fayetteville State University**

**The Motility of *Pseudomonas aeruginosa***

*Pseudomonas aeruginosa* is a Gram-negative pathogen that causes a multitude of diseases in various hosts. This bacterium is significant in the marshes of soil and generally found in ubiquitously throughout nature. Additionally, it is a microorganism that can survive various environmental conditions. *Pseudomonas aeruginosa* causes various infection, found in burn victims, and cystic fibrosis (CF) which is one disorder that has a high mortality rate when *P. aeruginosa* is associated. Cystic fibrosis is a genetic disease that causes patients to accumulate thick mucus in their lungs resulting in a chronic infection. *P. aeruginosa* infections are difficult to treat. One factor that aids in *P. aeruginosa* being so virulent is the bacterium's ability to be motile. This movement includes twitching, swimming, and swarming. It has been documented that there are many regulators that affect motility. In this review, we will address AlgR, RsmA, iron, and other factors that play a role in *P. aeruginosa* motility.

**Student Authors (s): Sethi, Sahil; UNC Chapel Hill**

**Mentors (s): Silver, Debra; Duke University**

### **mRNA Localization and Local Translation Regulate Neural Stem Cell Morphology During Brain Development**

In brain development, cortical neurons are formed through the differentiation of stem cells known as radial glial cells (RGCs). RGCs possess an elongated structure called the basal process that terminates with a basal endfoot. The endfoot tethers the cell to the basement membrane and is surrounded by migrating interneurons. RGC morphology defects are linked to neurodevelopmental disorders, but the mechanisms regulating RGC morphology remain poorly understood. Debra Silver's lab recently described mRNA transport within RGC basal processes and local translation in endfeet. Since these mechanisms are known to regulate neuron morphology, we tested whether they also do in RGCs. Arhgap11a encodes a RHO GAP with known roles in cytoskeleton regulation and its mRNA is RGC end-foot-localized. Consequently, knockdown of Arhgap11a was conducted by transfecting siRNAs along with a fluorescent reporter into embryonic mice in vivo. Concomitantly, we investigated the impact of Arhgap11a knockdown on neighboring cells by fluorescently labeling interneurons. All data were collected through blindly analyzing microscopy. Morphological RGC data were collected by creating and measuring 3D models. Interneuron data were collected through cell counting. Arhgap11a knockdown decreased RGC basal process complexity and endfoot-membrane contact area. Moreover, this non-cell-autonomously decreased the number of interneurons surrounding basal endfeet. We conclude that Arhgap11a regulates RGC basal endfoot morphology, which in turn, is associated with diminished interneuron migration. Further experimentation has since shown that Arhgap11a knockdown also disrupts cortical lamination post-natally. These findings reveal that mRNA localization and local translation not only regulate RGC morphology but significantly impact cortical development.

**Student Authors (s): Russ, Lindsey; North Carolina State University**

**Mentors (s): Marsden, Kurt; North Carolina State University**

### **Mixture of cyanotoxins induces molecular changes in larval zebrafish related to neurodegeneration**

Amyotrophic lateral sclerosis (ALS) is a fatal neurodegenerative disease characterized by degeneration of motoneurons. Only 10% of ALS cases are genetically inherited indicating that environmental factors contribute to the remaining 90% of sporadic ALS cases. Exposure to  $\beta$ -methylamino-L-alanine (BMAA), a ubiquitous environmental cyanotoxin, has been proposed as a risk factor for sporadic ALS. Another highly prevalent cyanotoxin, microcystin leucine-arginine (MCLR), co-occurs with BMAA in the environment and can build up in tissues. MCLR can inhibit protein phosphatases and plays a role in the hyperphosphorylation of tau, a process correlated with neurodegeneration. Because little focus has been directed towards adverse effects caused by exposure to cyanotoxic mixtures, the purpose of this analysis was to evaluate how cyanotoxins interact to cause molecular changes following exposure to a mixture composed of BMAA and MCLR. We exposed larval zebrafish to BMAA, MCLR, or both and evaluated global protein regulation using shotgun proteomics techniques. We found that exposure to mixture triggered more protein dysregulation than individual cyanotoxins. Next, I created a list of proteins strongly associated with neurodegenerative pathologies and examined their regulation. Larvae exposed to BMAA/MCLR mixture revealed a significant upregulation of TAR DNA-binding protein 43 (TDP-43), ( $P=0.0159$ ; fold-change=2.551) a transcriptional regulator whose cytoplasmic aggregates are a hallmark of ALS pathology. I also found that profilin-1 (PFN1) ( $P=0.0450$ ; fold-change=1.219), whose rare genetic mutations can lead to ALS, was significantly upregulated following exposure to MCLR. Our results emphasize the importance of evaluating mixtures of cyanotoxins when studying the link between environmental factors and neurodegeneration.

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**Student Authors (s):** Richardson, Melina; UNC Charlotte

**Mentors (s):** Afonin, Kirill; UNC Charlotte

**RNA–DNA fibers and polygons with controlled immunorecognition activate RNAi, FRET and transcriptional regulation of NF- $\kappa$ B in human cells**

Nucleic acid–based assemblies that interact with each other and further communicate with the cellular machinery in a controlled manner represent a new class of reconfigurable materials that can overcome limitations of traditional biochemical approaches and improve the potential therapeutic utility of nucleic acids. This notion enables the development of novel biocompatible ‘smart’ devices and biosensors with precisely controlled physicochemical and biological properties. We extend this novel concept by designing RNA–DNA fibers and polygons that are able to cooperate in different human cell lines and that have defined immunostimulatory properties confirmed by ex vivo experiments. The mutual intracellular interaction of constructs results in the release of a large number of different siRNAs while giving a fluorescent response and activating NF- $\kappa$ B decoy DNA oligonucleotides. This work expands the possibilities of nucleic acid technologies by (i) introducing very simple design principles and assembly protocols; (ii) potentially allowing for a simultaneous release of various siRNAs together with functional DNA sequences and (iii) providing controlled rates of reassociation, stabilities in human blood serum, and immunorecognition.

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**Student Authors (s):** Richardson, Casey; Holmes, Leonard; Mandjiny, Sivanadane; UNC Pembroke

**Mentors (s):** Upadhyay, Devang; UNC Pembroke

**Growth Kinetic Study of *Bacillus thuringiensis* under Various Conditions using Bioreactors**

*Bacillus thuringiensis* (Bt) is a soil-dwelling, Gram-positive bacterium that is used as a biological pesticide and used to genetically engineer plants due to the toxic proteins it produces. *B. thuringiensis* was studied in batch cultures to determine the specific growth rates and doubling times. The purpose of this experiment was to research the growth kinetics of *Bacillus thuringiensis* in a 2L bioreactor and a 5L bioreactor containing growth media at different environmental conditions. Fermentation parameters were controlled by utilizing a Sartorius Stedim Biostat® A+ bioreactor system for bacterial growth. The environmental conditions included temperature, agitation, and aeration. The specific growth rates of *B. thuringiensis* were determined. The optimal conditions for the 2L bioreactor were 200 RPM, 30°C, 1.5 VVM, and with the highest specific growth rate 0.30 hr and the lowest doubling time 1.0 hr. For the 5L bioreactor, the optimal conditions were 150 RPM, 30°C, 1.5 VVM, and with the highest specific growth rate 1.2 hr and the lowest doubling time 0.26 hr.

**Student Authors (s): Rashad, Layla; Viera, Sonia; Fayetteville State University**

**Mentors (s): Jiazheng, Yuan; Fayetteville State University**

### **Comparative analysis of lipid composition between a soybean EMS mutant and USDA checks**

Soybean seeds are an important commodity because of their high concentration of oil. Soybeans are the most valuable legume crop due to its high oil content in soybean seeds, which is one of the most important sources for human consumption and animal feed. In order to study the molecular pathways that can be used to improve soybean oil content, a new monofunctional ethylating agent called ethyl methane sulfonate (EMS) can be used to create the EMS mutagenized soybean population and thereby select improved quality of soybean lines. EMS mutagenized populations can be examined for the improvement of oil content in mutant lines by screening these lines under field condition. The high yielding mutant FM6-847 was developed through EMS mutagenesis at Southern Illinois University. FM6-847 was derived from soybean cultivar Forrest and the quality traits such as oil and protein contents of FM6-847 have not been evaluated in North Carolina. The objectives of this study are to analyze the correlation of soybean oil, protein, and their components in the mutant FM6-847 and compare these quality traits with that of three USDA checks LD00-2817, LD06-7620, and LD07-3395 from a field trial at Fayetteville, NC over a period of two years (2016–2017) and . Our results will provide useful information for soybean breeding and trait improvement through the dynamic analysis in EMS mutant and USDA checks.

**Student Authors (s): Perry-Garnette, Gracie; Guilford College**

**Mentors (s): Lee-Brown, Melanie; Guilford College**

### **Stoney Coral Tissue Loss Disease in the Turks and Caicos Islands**

The Turks and Caicos Islands (TCI), located 600 miles east-southeast of Miami, FL, are home to the largest barrier reef in the Atlantic Ocean. Tourism is the major driver of the country's economy hosting 1.6 million visitors in 2019. Visitors come to enjoy the miles of beaches and the vibrant coral reef and its inhabitants. The coral shallows in the Bahamas and the Caribbean are currently under the threat of a new disease, Stony Coral Tissue Loss Disease (SCTLD). Discovered in Southern Florida in 2014, this disease is now infecting corals throughout the Caribbean. One of the newest areas with this disease are the barrier reefs around TCI. The Infection was first detected in corals in this region in April 2019. The morphology of infected corals includes bleached tissue that sloughs off of the skeletal structure of the animal. Researchers near Florida have successfully treated SCTLD with antibiotics applied directly to the corals, implying that bacteria the infective agents. If SCTLD is left untreated, it could kill susceptible corals and destroy the reef ecosystem. Our research plan is to survey the extent of the disease, and identify and map the affected corals on the reefs of North and Middle Caicos Islands. We have applied for authorization to sample affected corals for high-throughput microbiome analysis to identify the causative bacterial agent or population. The results of this project will be shared with the Department of Environment and Coastal Resources (DECR), School for Field Studies- South Caicos, and the Reef Fund.

**Student Authors (s):** Obi, Nnamdi; North Carolina School of Science And Math

**Mentors (s):** Monahan, Kim; North Carolina School of Science And Math

### **Investigating the potential synergistic effects between Rapamycin and MSDC-0160 in treating Parkinson's Disease**

Parkinson's Disease (PD) is a chronic neurological disorder that affects millions every year in the United States. PD works by destroying dopamine generating neurons in the brain, creating a loss of dopamine resulting in tremors, slowed movement, a loss of automatic movements, speech changes, and impaired posture or balance. The standard treatment for the disease, Levodopa (L-Dopa), becomes unsustainable, as some motor and nonmotor features associated with Parkinson's disease do not respond well to L-Dopa or become resistant to L-Dopa treatments as the disease progresses. Alternatives to L-Dopa have been suggested, which focus on destroying lewy bodies, or clumps of alpha-synuclein protein that aggregate in the cell. In this experiment, two possible alternative treatments were tested: Rapamycin and MSDC-0160 (Mitoglitazone). Literature suggests that the way these two drugs work is related. If so, then by combining these two treatments, there could be possible synergistic effects between the two treatments that could suggest a more viable treatment for PD. These treatments were tested on *Caenorhabditis elegans*, a common model organism for PD due to how similar its dopamine-creating neurons are to Humans. Both treatments were tested separately, with Rapamycin tested at a concentration of 200  $\mu\text{M}$  and MSDC-0160 at both 10  $\mu\text{M}$  and 100  $\mu\text{M}$ . A combination treatment was also prepared with Rapamycin and MSDC-0160 at concentrations of 200  $\mu\text{M}$  and 100  $\mu\text{M}$ , respectively.

**Student Authors (s):** Leggett, Ace; Wingate University

**Mentors (s):** Schiller, NaTasha; Wingate University

### **Toxicity of dCas9 protein in mammalian myoblast cells**

Deactivated Cas9 (dCas9), fused with a Krueppel-associated box (KRAB) domain, can act as a targeted transcriptional repressor by binding to a nucleotide protospacer adjacent motif (NGG), as directed by a guide sequence. This form of reversible central dogma interference is termed CRISPRi. The Cas9, from which this dCas9 is derived, is produced naturally in several species of bacteria. However, dCas9 has been shown to induce changes in morphology and growth rates in laboratory strains of *E. coli* (Cho et al., 2018). The ability of CRISPRi technology to reversibly disrupt RNA and protein production holds promise regarding gene therapy in humans. Unfortunately, the toxicity of dCas9 in eukaryotic cells is unknown. This experiment explores the effect of different concentrations of KRAB::dCas9::mCherry on C2C12 mouse myoblast cells. Mouse myoblast cells were transfected with plasmid DNA containing KRAB::dCas9::mCherry. Post-transfection, known metabolic proteins NADPH 4 oxidase (NOX4), Ark5/NUAK1, and SNARK/NUAK2 were analyzed by immunocytochemistry to assess metabolic stress in each treatment group. The lowest concentration group, receiving 0.2ng/ $\mu\text{L}$  of KRAB::dCas9::mCherry, exhibited healthy mCherry positive cells with higher amounts of myoblast differentiation into maturing myotubes compared to the higher concentration groups. All KRAB::dCas9::mCherry treatment groups exhibited increased expression of NOX4, and altered expression of NUAK1 and NUAK2 compared to controls. The highest concentration groups, 1.18ng/ $\mu\text{L}$  and 0.3ng/ $\mu\text{L}$  respectively, exhibited higher cell death compared to controls and the lower concentration group. The results of this study suggest that current standards of KRAB::dCas9::mCherry concentration ( $\sim 4\text{ng}/\mu\text{L}$ ) in mammalian cell transfection may be leading to unwanted metabolic effects.

**Student Authors (s):** Kuriakose, Irene; Queens University of Charlotte

**Mentors (s):** Easterwood, Jennifer; Queens University of Charlotte

**The Attempted Isolation of *G.rubripertincta* Bacteriophage and Annotation of *G.terrae* Phage "YungMoney"**

In the Spring of 2020, attempts were made to isolate bacteriophage using the bacterial host *Gordonia rubripertincta*. This project was a part of the SEA-PHAGES program, in which students work to discover and characterize new bacteriophage, viruses with the ability to infect bacteria and the potential to fight bacterial infections. Over the course of eight weeks, five sets of soil samples were collected and tested for signs of phage, using enriched isolation methods. Various changes were made to the methods to reduce suspected contamination. These changes included extra filtration, different incubation temperatures, and an off-soil method where soil samples were incubated, centrifuged, and filtered before adding *G. rubri*. Though these changes helped resolve contamination, phage was not isolated, and protocols could not be continued due to the COVID-19 pandemic and quarantine orders. In the Fall of 2020, the *Gordonia terra* phage "YungMoney", sequenced at the Pittsburgh Bacteriophage Institute, was adopted for genome annotation. The bioinformatics software DNA Master and resources HHPred, NCBI Blast, Starterator, and Phamerator are currently being used to annotate the genome by analyzing the coding regions, starts, and functions of individual genes. "YungMoney" is of the Siphoviridae morphotype and is circularly permuted. After isolation, this phage was registered in the Actinobacteriophage Database, a phage database open to the public, and is currently one of twenty-one sequenced phages in the DC1 subcluster. "YungMoney" tentatively has 60,370 base pairs, 95 open reading frames, and a 67.3% Guanine-Cytosine (GC) content.

**Student Authors (s):** Jo, David; Varghese, Shannyn; William Peace University

**Mentors (s):** Bonner, Lisa; William Peace University

**Baseline biodiversity of the aquatic biota in an undisturbed hardwood forest slated for road construction**

Shady Acres is a hardwood forest in Wake Forest, NC. A second order, unnamed tributary empties into Smith Creek, which drains into the Neuse River. In 2020-21, a road construction project will transect the property, which offered a unique opportunity to study the effects of construction on the stream ecosystem. We performed an initial census in 2017, and in 2019 began a detailed study to document the water quality and biodiversity of the stream prior to the start of construction. Future studies will be done during and after construction. Although most of the water chemistry results were within normal ranges for the Central Piedmont region, the macroinvertebrate diversity was lower than expected. Notable siltation due to residential construction on the border of the property may have already affected the biota. The dominant species were pollution-tolerant species of caddisflies, stoneflies, mayflies and dipterans. The most common large invertebrate species was the crayfish, *Cambarus latimanus*. Fish populations were dominated by creek chubs (*Semotilus atromaculatus*) and rosieside dace (*Clinostomus funduloides*). Creek chubs are a highly adaptable species that are tolerant of disturbance, silt and pollution. We expect this species will endure change from construction fairly well. However, the rosieside dace is a sensitive species that is intolerant of turbidity and silt thus only does well in clear, cool water in forested areas. In the future, we expect deforestation and siltation from road construction to greatly affect the macroinvertebrate and fish populations.

**Student Authors (s):** Howard, Myah; Fayetteville State University

**Mentors (s):** Graham, Justin; Fayetteville State University

### **INVESTIGATING PYOCYANIN REGULATION IN PSEUDOMONAS AERUGINOSA PATHOGENESIS**

*Pseudomonas aeruginosa* is a Gram-negative opportunistic bacterium capable of causing acute invasive infections such as pneumonia in ventilated patients and chronic, life-long infections in the airways of individuals with the genetic disease cystic fibrosis (CF). *P. aeruginosa* causes approximately 51,000 healthcare-associated infections per year. These infections are the direct result of the many virulence factors of *P. aeruginosa*. The virulence factor addressed in this review is pyocyanin (PCN), a redox-active phenazine. Pyocyanin is a blue-green colored toxin that is discharged and is a virulence factor that is responsible for the increasingly high mortality rate associated with CF infections. Pyocyanin is a highly regulated toxin. Various genetic regulators will be addressed in this review. A few that will be highlighted because they have been shown to affect PCN production are RsmA, a small RNA binding protein, AlgR, the alginate response regulator and iron (Fe). These three regulators have also been previously shown to work together to regulate other virulence factors in *P. aeruginosa*. The purpose of this review is to compile a review information that brings light to pyocyanin regulation by global regulators like RsmA and AlgR, as well as small molecules such as iron. This study will focus on summarizing information from other detailed studies to see just how these regulators have worked to define *P. aeruginosa* as the unique pathogen we know it to be today.

**Student Authors (s):** House, Stefanie; Fayetteville State University

**Mentors (s):** AbuBakr, Samer; Fayetteville State University

### **THE EFFECT OF SOIL TYPES ON THE DIVERSITY OF MICROORGANISMS**

The aim of this research is to determine the relation between soil type and microbial communities. Specific regions in Cumberland County were chosen as sampling sites, then serial dilutions were performed on sampled soils followed by streaking for single colonies and DNA extraction. The extracted DNA will be used as a template for PCR. Then, PCR products will be sent out for sequencing. The data gathered could be crucial for biogeoprinting and forensic analysis as some evidence has shown that varying microbiome taxa can be used to determine the geographical locations of soil samples (Araoju 2009; Giampaoli 2014).

**Student Authors (s):** Hlophe, Nomfanelo; **Methodist University**

**Mentors (s):** Antharam, Vijay; **Methodist University**

### **Functions of Genes Linked to the Pathogenicity of Yeast *Candida albicans***

My research project is based on examining RNAseq data and annotating the function of differential genes in mice inoculated with *Candida albicans* that were treated with and without the antibiotic cefoperazone. The functions of these genes were retrieved from literature databases such as PubMed and the *Candida* Genome Database. Gene functions were determined based on their links to *C. albicans* pathogenicity, relationship to other genes in regulatory networks, and the effect of cefoperazone on the transformation of *C. albicans* from a commensal to pathogenic fungi. For example, three differential genes that *C. albicans* upregulates in the presence of antibiotic include: (1) Bcy1, a regulator of cell differentiation and death. (2) Protein kinase A: a regulatory subunit involved in regulation of filamentation, phenotypic switching and mating (3) Sap9, which modifies *C. albicans* adhesion facilitating epithelial cell damage during infectivity. The roles of the top differential genes caused by antibiotic insult to *C. albicans* will be discussed as well as the role of antibiotic cefoperazone in switching yeast phenotype from commensal to pathogenic organism.

**Student Authors (s):** Thota Amit; **UNC Charlotte**

**Mentors (s):** Yan, Shan; **UNC Charlotte**

### **Mechanisms of Polymerase $\eta$ in genome integrity and cancer biology**

Cells in our body are constantly exposed to various endogenous and exogenous genotoxic insults, such as UV radiation, ionizing radiation, or reactive oxygen species, which result in damaged DNA. Multiple stress response mechanisms have been evolved to maintain genomic stability under these stressors. One such mechanism is DNA Damage Response pathway (DDR), which is triggered for enough time to repair DNA lesion and cell survival. Unfortunately, a variety of DNA damages are unrepairable or occur during replication, inhibiting DNA polymerase activity while also increasing the potential of replication fork collapse, or leading to unsuccessful recovery from cell cycle arrest and apoptosis or cell death. DNA Damage Tolerance pathway (DDT) takes over in such instances to bypass different DNA lesions to continue replication, transcription, and cell cycle progression, albeit in an error prone fashion. DDT is mainly executed through a group of specialized DNA polymerases named Translesion Synthesis (TLS) polymerases, one of which is Pol  $\eta$ . Cancer cells are showing sensitivity to Pol  $\eta$  deficiency or inhibition, pointing to a potential way to cure certain types of cancer. This presentation will focus on uncovering the connections between DDR and DDT pathways in oxidative stress. The function of Pol  $\eta$  is also discussed. Understanding the holistic function of Pol  $\eta$  in genome integrity and cancer biology under different circumstances leads to better medical approaches to diseases like cancer.

**Student Authors (s):** Chandler, Chayse; North Carolina School of Science And Math

**Mentors (s):** Monahan, Kim; North Carolina School of Science And Math

**Assessing the Effectiveness of the Extract Isolated from *Hericum erinaceus* as an Acetylcholinesterase Inhibitor to Treat Alzheimer's Disease**

Alzheimer's Disease (AD), a type of dementia, is attributed to the overproduction of the amyloid-beta (A $\beta$ ) protein caused by the presence of the amyloid precursor protein (APP). The excess A $\beta$  causes cerebral atrophy, neuritic plaques, and neurofibrillary tangles. These effects cause neuronal death and synaptic dysfunction, which leads to loss of memory and confusion. This project focuses on the strategy of deriving therapeutics to control the A $\beta$  protein by finding an effective acetylcholinesterase (AChE) inhibitor. Research indicates that low levels of ACh are correlated with high levels of the A $\beta$  protein, thus, an AChE inhibitor will hypothetically decrease the level of the A $\beta$  protein and relieve symptoms. The most effective known AChE inhibitor is galantamine--an alkaloid isolated from *Lycoris radiata*. Many studies since then have demonstrated how phytochemicals and bioactive compounds in fungi are significantly more effective and have less side-effects than artificial derivatives. This particular project will focus on assessing the ability of the extract isolated from *Hericum erinaceus* as an AChE inhibitor. The first assay conducted observed if there was toxicity in the extract by exposing wildtype *Drosophila melanogaster* to the extract at various concentrations. It was found that the *H. erinaceus* extract has significantly lower minutes until paralysis compared to galantamine and the negative control ( $p < 0.0001$ ). The assays currently being conducted include the Ellman's AChE assay, which quantifies the ability of the chemical to inhibit this enzyme, and redoing the paralysis assay with a strain of *D. melanogaster* that expresses the A $\beta$  protein.

**Student Authors (s):** Giang, Minh Huy; Locklear, James; Tuton, Jared; Almeida, Michael; UNC Pembroke

**Mentors (s):** Bahr, Ben; , UNC Pembroke

**Comparison of dietary supplements and an exercise mimetic for their ability to counteract memory-impairing protein accumulation stress and associated synaptopathology**

Diets rich in antioxidants and plant-based products are considered as routes to slow cognitive decline and augment autophagy-lysosomal activity, which is negatively affected by factors linked to age-related proteinopathies (Miquel et al. 2018 Ageing Res Rev 42:40; Sohn 2018 Nature 559:S18; Almeida, Bahr & Kinsey 2020 Internatl Review Neurobiol 154:11). We evaluated different classes of natural products for their effects on synaptic markers in hippocampal explants. Three daily treatments with American ginseng (PanQ) and Panax ginseng exhibited distinct effects on synaptic marker GluR1 – 3.2-fold ( $p < 0.01$ ) vs. 20% (N.S.) increase, respectively – and on lysosomal cathepsin B (CatB; 3-fold vs. 52% increase), a protein-clearing hydrolase whose enhancement is protective in models of Alzheimer's disease (AD), Parkinson's disease, and MCI (Hwang et al. 2019 Internatl J Mol Sci 20:4432). Bacopa and flavonoid derivatives also increase synaptic markers, and neuroprotective marine-based supplements are being assessed for CatB modulation. In comparison with exercise mimetics, we used creatine analog  $\beta$ -guanidinopropionic acid ( $\beta$ -GPA) that induces autophagy-lysosomal processes. Nine-day  $\beta$ -GPA treatment on brain slices exhibited time-dependent CatB enhancement and increase in CatB-30/CatB-25 ratio as generated by PanQ and Bacopa. However,  $\beta$ -GPA did not appreciably influence GluR1.  $\beta$ -GPA and PanQ have comparable synaptic protection in a model of compromised autophagy-lysosomal system and AD-type synaptopathology induced by chloroquine. Thus, of the many memory-supportive supplements available, those that positively influence protein clearance pathways are likely the best suited to counteract dementia-linked cognitive decline. Such beneficial natural products are also ideal to be combined with the synaptic protection related to exercise.

**Student Authors (s):** Gebremichael, Hanna; North Carolina School of Science And Math

**Mentors (s):** Monahan, Kim; North Carolina School of Science And Math

### **Potential Quorum Quenching Effects of Galactosamine on Biofilm Formation of Enterobacter Aerogenes**

In recent years the surge of antibiotic resistance has caused concern as researchers find new ways to combat the rapid adaptations of bacteria. Bacteria have a unique system known as quorum sensing that allows them to make autonomous actions within their populations including the formation of compounds known as biofilms. These biofilms are regulated through an intricate system of communication through the use of signal molecules known as autoinducers. These autoinducers are released and accepted by neighboring bacteria and eventually lead to the expression of genes that create biofilms. One specific proposed method of restricting bacteria virulence is through a process known as quorum quenching. Quorum quenching is the mechanism by which the connection between the autoinducers or signaling molecules and the corresponding receptor proteins are interrupted. For my project I hoped to focus on preventing the detection of autoinducers in a strain of bacteria known as *Enterobacter aerogenes*. In gram-negative bacteria, such as mine, the common autoinducer is AHL. In order to simulate the quorum quenching process I hope to inhibit the binding of these AHL molecules to the LuxR receptor which is a key protein in the process that leads to the gene expression and formation of biofilms. One specific studied compound that is known to bind to the LuxR receptors and prevent the binding of AHL molecules is a compound called N-Acetyl-Glucosamine. My project focuses on the effect of a glucosamine derivative known as galactosamine on restricting biofilm formation.

**Student Authors (s):** Foust, Samantha; Lord, Clara; Burnett, Braxton; Polinski, Patricia; Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)

**Mentors (s):** Tuberty, Shea; Appalachian State

### **Effects of Urbanization on Water Quality**

This project explored the impacts of impervious surface and urbanization on water quality in North Carolina streams as determined by water chemistry, erosion, and aquatic macroinvertebrate biomonitoring. Sites were selected using USGS water discharge locations and NC Department of Environmental Quality (NCDEQ) benthic monitoring sites. The hypotheses proposed were: a) water quality degrades in areas with increased urbanization, and, b) long-term water quality biomonitoring is an effective tool to determine water quality. To measure urbanization in each stream the percent impervious surface was estimated using Google Earth. Using our macroinvertebrate collections and NCDEQ historical samples from the same locations, the taxa were identified, counted and sorted by trophic groups and used to determine the NC Biotic Index, Simpson's Diversity Index, and species richness. The urban streams (Marsh & Walnut Cr) had a majority of collector type macroinvertebrates, the rural creek (Swift Cr) had an even balance of shredder and collectors, and the swamp creek (Angola Cr) had no collectors. At the urban sites, there has been rapid urbanization leading to increased impervious surface over time. Using derived macroinvertebrate data, it was concluded that the swamp/coastal creek had different physical characteristics compared to the piedmont streams, causing one to have a 'Severe' rating. The consistently highest overall water quality was the rural stream (Swift Cr) with a 'Good' classification, supporting our hypothesis that urbanization/impervious surfaces degrade water quality while urbanized streams continue to degrade over time, indicating the need for increased conservation and best management practices.

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**Student Authors (s): Finn, Seana; Shaw University**

**Mentors (s): Butler, Eric; Shaw University**

### **Investigating Carrying Loads in Raptors Using Reported Prey Weights**

Birds of prey are often in direct competition with terrestrial carnivores, forcing them to relocate prey items to higher perches. This requires carrying the weight of the prey item, and may limit the size of prey which a bird of prey can effectively utilize. Previous methods to estimate maximum carryable loads range from trials in which birds are loaded with weights and induced to fly to studies of climb rates in migrating birds. However, different studies contradict one another, with estimated maximum loads ranging between 20-50% of their weight. In contrast, other authors have noted observations of raptors carrying loads that exceed 50% of their own body weight. In this study we analyzed the literature for raptorial birds carrying large prey items. In certain cases, the weight of the prey and the raptor were included, while some papers did not include weights for either the prey or raptors and additional literature was consulted. Our results suggest that raptorial birds can carry maximum loads up to, and perhaps exceeding, 100% of their body mass. There may be several reasons why the results from our study differ from previous studies. In our experiment it was impossible to separate aerobic activity from anaerobic activity, whereas some prior studies exclusively looked at aerobic activity. In addition, experiments on captive raptors may not accurately represent the athletic capabilities and motivation levels of wild raptors. Despite the problems of estimating the prey weights, this line of inquiry highlights the need for further work in this area.

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**Student Authors (s): Donnolo, Isabel; UNC Chapel Hill**

**Mentors (s): Goforth, Kayla; UNC Chapel Hill**

### **Sea Turtles Use Sargassum Odors to Locate Nursery Habitats**

Animals use chemical cues, or odors, to aid in navigation, to locate food, to mark their territory, and for communication. For example, many marine animals, including fishes, sea turtles, and seabirds, use a chemical called dimethyl sulfide to locate foraging sites because dimethyl sulfide is produced as a byproduct of marine algae, and indicates an oceanic region of high productivity. Sea turtles in particular have been shown to detect other food-related airborne odors, and it is possible turtles rely on these chemical cues to aid in their navigation to specific habitats. One hypothesis is that odors may help hatchling age sea turtles locate their nursery habitats - sargassum mats. Sargassum mats are large aggregates of brown algae that hatchlings visit during their initial oceanic migration, likely using them for food and shelter. To investigate whether sea turtles can detect sargassum odors, they were exposed to airborne and waterborne odors of food, sargassum and artificial sea water. While experimental analyses are still in progress, we expect that when turtles are presented with sargassum odors they will exhibit a positive reaction, such as keeping their nostrils above the surface of the water, increasing paddling or swimming, or spending more time near the odor.

**Student Authors (s): Dellinger Alexander; Gaston College**

**Mentors (s): Maggiotti Virginie; Gaston College**

### **Tracking Antimicrobial Resistance and Water Quality in Surface Water Microbiomes along the Catawba River Basin**

According to The Centers for Disease Control and Prevention (CDC), more than 35,000 people in the US die per year from antimicrobial-resistant infections. The scope of this problem is only growing as more pathogenic bacteria display multidrug resistance, both in clinical and non-clinical settings. Only recently has research focused on resistant bacteria in environmental samples as a contributor to these deadly infectious diseases. Wastewater Treatment Plants may act as a vector for propagating antimicrobial resistance genes (ARGs) in surface water microbiomes, with post-treatment wastewater effluent often containing trace quantities of antibiotics. Federal law does not require testing for ARGs in the water supply, and local water treatment facilities do not voluntarily complete this testing. Residents of the Charlotte/Mecklenburg region may be at risk of exposure to these unknown and untested contaminants through their main water supply, the Catawba River. This study was conducted to build a resistance profile from samples taken at 12 sites on the Catawba River. Collection sites were chosen based on their public accessibility and proximity to potential pollution sources. Bacterial colonies were isolated from the samples, and resistance profiles were constructed using disk diffusion. This study also analyzed the chemical composition of the water samples, testing for levels of ammonium, nitrate, arsenic, chromium, copper, iron, nickel, and pH. All values tested were within EPA limits. The next steps in this research will include genomic analysis of samples to identify bacterial species and the levels of ARGs.

**Student Authors (s): Darrigrand, Katherine; Campbell University**

**Mentors (s): Reynolds, Evan ; Campbell University**

### **Enzymatic dynamic kinetic resolution for the stereoselective synthesis of alpha-hydroxy ketones**

Thiamine diphosphate (ThDP)-dependent enzymes have been explored for their ability to produce alpha-hydroxy ketones through benzoin condensation reactions. Two of the most common enzymes for this application have been Benzaldehyde Lyase (BAL) from *Pseudomonas fluorescens* and Benzylformate decarboxylase (BFD) from *Pseudomonas putida*. These enzymes have been successfully employed in benzoin condensations to produce alpha-hydroxy ketones with high levels of chemo- and enantioselectivity. Less explored, however, is the ability of these enzymes to control the configuration about multiple chiral centers. Previously BAL has been used in kinetic resolutions of racemic substrates to produce alpha-hydroxy ketones with high levels of enantio- and diastereoselectivity. The limitation of this approach is that the maximum possible yield is 50%, as only one of the substrate enantiomers is accepted by the enzyme. Modifying the reactant so that substrate enantiomers can interconvert would allow for a theoretical yield of 100%, in a so-called dynamic kinetic resolution. This project focuses on developing an enzymatic dynamic kinetic resolution of racemic alpha-substituted aldosterone substrates using the enzymes BAL and BFD. We have successfully synthesized the substrates, cloned the enzymes, and purified the BFD enzyme, with the use of this enzyme to catalyze chemical reactions forthcoming. The successful completion of the project will result in an efficient and environmentally-friendly approach to producing synthetically valuable alpha-hydroxy ketone products.

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**Student Authors (s):** Casey, Jack; Davidson College

**Mentors (s):** Ramirez, Julio; Davidson College

**Synaptic Plasticity of the Crossed Temporodentate Pathway in Ovariectomized Female Sprague-Dawley Rats**

Neuroplasticity is how the brain adapts to damage by having healthy brain regions compensate for degeneration of other brain regions. Estrogen promotes the formation of excitatory synapses in the dorsal hippocampus, increases dendritic spine density in pyramidal cells of the hippocampus, and has receptors throughout the brain. Estrogen likely has a role in neuroplasticity. I am examining the effects of decreased estrogen concentration on neuroplasticity in the crossed temporodentate (CTD) pathway and the septodentate (SD) pathway. Quantifying neuroplasticity in ovariectomized (OVX) female rats, non-OVX female rats, and male rats will elucidate the role of estrogen in this protective mechanism because the ovaries are the main source of estrogen. To quantify neuroplasticity, the entorhinal cortex (EC) in the right brain hemisphere is damaged. This right EC lesion is a well-established model for studying neuroplasticity, especially because the EC is known to degenerate in humans with Alzheimer's disease. Twelve days after EC degeneration, electrophysiological recordings are taken from the CTD pathway which projects from the left EC to the right hippocampus. The brain is then stained for acetylcholinesterase to quantify plasticity in the SD pathway, which projects from the septum to the hippocampus. When the EC is damaged, the SD and CTD pathways should increase in size to compensate for the loss of input to the hippocampus from the right EC. Preliminary histological results indicate that non-OVX female rats have greater SD plasticity dorsally than male rats, while both males and non-OVX females exhibit similar CTD plasticity as measured by electrophysiological recordings.

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**Student Authors (s):** Byrd, Ashley; UNC Chapel Hill

**Mentors (s):** Goforth, Kayla; UNC Chapel Hill

**Quantifying sea turtle behaviors using accelerometers**

Behavioral experiments provide useful insight about how animals operate in their natural environments. However, data for these types of experiments are usually collected with video footage, and then analyzed by human observers who may be influenced by bias and fatigue. Because of this, more accurate techniques to quantify animal behavior are highly sought after. One such method is the use of small electronic devices, called accelerometers. Accelerometers are electromechanical devices that are used to measure acceleration and/or position by detecting motion along the x, y, and z axes. This provides information about the animal's position, orientation, and direction of movement. These devices also allow for rapid collection of data that is more accurate than traditional video analysis methods. We aim to use accelerometers to effectively quantify the behaviors of juvenile loggerhead sea turtles (*Caretta caretta*) for associative learning and navigation experiments. We plan to identify a variety of turtle behaviors including turning and diving, but the key behavior we aim to quantify is a food-seeking behavior characterized by rapid movements of the front and back flippers, with the turtle's head out of the water. Preliminary analyses have found patterns in the accelerometer data that correspond with specific behaviors, including the aforementioned food-seeking behavior. Currently, there are very few studies on sea turtle behavior that use accelerometers, and as such, this study seeks to provide tools for future researchers.

**Student Authors (s):** Blango, Dymon; East Carolina University

**Mentors (s):** Balakrishnan, Christopher; East Carolina University

#### **Identification of sex chromosome-linked chromosomes in whole genome assemblies**

Sex chromosomes in birds and mammals are notoriously difficult to sequence and assemble due to their complexity. Whereas in most mammals, males carry an X and Y chromosome, in birds females are the heterogametic sex, carrying Z and W chromosomes. This project examined the unique evolutionary dynamics of the sex-determination chromosomes by analyzing genome data of birds. The primary objective of this project was to identify and annotate Z-, W-linked and autosomal scaffolds from a whole genome assembly of the black-headed duck *Heteronetta atricapilla*. To do so we collected whole genome sequence data from 14 individuals of this species and analyzed the data using a combination of bioinformatics software and R scripts. We expected that W chromosome scaffolds would be present only in female birds and that Z-linked scaffolds would be present in two copies in males but only one copy in females. This logic enabled us to confidently identify scaffolds as being either linked to the Z chromosome or the W chromosome. This study contributes to the understanding of genome structure and function.

**Student Authors (s):** Barnett, Zachary; East Carolina University

**Mentors (s):** Limberis, Loren, East Carolina University

#### **Modeling PhyB-PIF3 Interactions**

Phytochrome B (PhyB) is a plant protein that is conformationally photosensitive and involved with regulating plant growth and development. Upon being irradiated by red light (620 – 670 nm), PhyB takes on its active form, Pfr. Once in the active form, Pfr becomes capable of binding to a separate protein, known as phytochrome-interacting factor (PIF3), yielding a Pfr-PIF3 complex. Alternatively, in the presence of far-red light (700 – 750 nm), Pfr reverts back to its inactive form, Pr, and unbinds from PIF3. In plant cells, the photosensitive functionality of PhyB allows for activation/inactivation of a multitude of transcriptional signal cascades. Thus, the binary nature of PhyB dependent upon the presence or absence of red light allows for operation as a molecular switch. Presented here is an initial application platform modeling the aggregation and disaggregation behavior of a suspension of polystyrene beads coated in either PhyB or PIF3 and irradiated with red light and far-red light. The model was completed using the free and open-source 3D computer graphics software, Blender. A variety of freely available plug-ins including BlendMol, PyMol, and MCell were used to import protein models and assist with molecular dynamics. This photo-switchable mechanism may offer insight into the development of biohybrid devices that could apply PhyB/PIF3 interaction for varied biotechnological applications.

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**Student Authors (s): Rönn, Alva; UNC Chapel Hill**

**Mentors (s): Goforth, Kayla; UNC Chapel Hill**

**Sea turtles show interest in waterborne plastic odors**

Earth's oceans are filled with millions of tons of plastic debris, and this volume continues to grow. This plastic pollution impacts marine fauna, causing injuries and fatalities due to entanglement, smothering, or ingestion. Sea turtles in particular have been found with large amounts of plastic in their guts. While it was previously believed that sea turtles might be consuming plastic debris because they visually confuse it with prey, recent studies show sea turtles may be responding to and recognizing the odors of biofouled plastic as opposed to the sight of it. Biofouled plastic refers to plastic that has been submerged in sea water for some time and is colonized by various microorganisms. These microorganisms release dimethylsulfide, which is used as a foraging cue by sea turtles because it indicates areas of high primary productivity and thus food availability. While studies have investigated turtle responses to airborne biofouled plastic odors, sea turtles spend the majority of their lives under water and the role of waterborne plastic odors is currently unknown. To address this question, we investigated the response of sea turtles to waterborne biofouled plastic odors, as compared to food and seawater. Analyses are currently in progress, but to assess interest in an odor, we quantified time spent near that particular odor, with a larger amount of time indicating a positive attraction. A positive attraction to the in-water odors of biofouled plastic could further help to explain the ingestion of plastic debris by sea turtles.

## Oral Presentations

### Business & Economics

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**Student Authors (s): Richman, Alysea; Elon University**

**Mentors (s): Liu, Xin; Elon University**

**How does resale value influence consumers' purchasing behavior and firms' optimal decisions?**

To analyze the effect of offering recycling service on home-goods retailer's pricing decisions and profitability, we conducted a survey to obtain consumer's valuation of used home goods and developed an analytical model to examine optimal pricing strategy. The survey was distributed among Elon University's faculty and students. A large majority of respondents were female, freshman and have bought both new and used furniture. It was found that students selling furniture that had been purchased new preferred giving a discount of 20-30%. Students selling previously used furniture to a local firm thought that the appropriate discount rate was 40-59%. Students purchasing "like new" products believed that the discount rate should be 20-30% while "used" or "worn" items should be discounted 40-59%. Participants who purchased new items reported they were less likely to resell those items than students who bought used home goods. From the pricing models, we compared the retailer's profit with recycling service vs. without. Given the cost and salvage value of home goods, we determine the retailer's optimal price and recycling compensation to the consumers who are willing to resell their home goods after use. Our findings indicate that when salvage value of used home goods is relatively low, offering recycling service to consumers is more beneficial by providing higher prices.

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**Student Authors (s):** Vutz, Tyler; Barahona, Emely; Raflund, Julia; Coupet, Sebastien; Queens University of Charlotte

**Mentors (s):** Cox, Steven; Queens University of Charlotte

### **Streaming Services in the Pandemic**

The specific problem we are attempting to solve revolves around the current pandemic and how online streaming platforms have adapted and survived, will they last?. Will the rise of streaming services, especially during the pandemic, lead to people dropping cable entirely? This research provides insight into a shift in lifestyle and demonstrates how important streaming services are in our lives. For decades people have been using cable, but due to the pandemic they might be seeing their end. This is a strong trend that my team expects will continue far into the future with many new ideas and adaptations of the familiar streaming/community watching ideal rising up, which leads to our main research implication. Due to so many new services arising from the pandemic we might run into an issue finding reliable sources of data to pull comparisons from for more accurate results. Our second and third implications involve reading the data correctly and participants not answering the survey correctly or giving false information. We will be emailing surveys with a snowball effect method, meaning we will send them off to a handful of people that we know and then leave it up to them to send it along to others, and so on.

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**Student Authors (s):** Budsworth, Zoe; Elon University

**Mentors (s):** Rosey Bao; Elon University

### **Effects of National Culture on Corporate Social responsibility**

Corporate Social Responsibility (CSR) is a voluntary business practice based on ethical values and respect for employees, communities and the environment, which contributes to sustainable business success (IBLF, 2003). Much research on CSR over the past 10 years has focused on the relationship between CSR and corporate financial performance. However, there has been limited understanding on why or why not firms behave in socially responsible ways. Moreover, most existing papers focus on the CSR performance relationship within a single country and do not offer comparison with other countries. This paper tries to fill in these gaps of previous studies by examining the relationship between the national culture dimension of collectivism and corporate social responsibility (CSR). Specifically, I propose that collectivism positively affects CSR. Furthermore, this relationship is weakened by high levels of corruption but strengthened by high levels of regulatory quality. These hypotheses are developed based on the institutional theory and the idea that the way a firm behaves depends on the national institutions within which they operate.

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**Student Authors (s):** de Gorter, Brooke, Jordan Brown, Casey Carrigan; Queens University of Charlotte

**Mentors (s):** Cox, Steven; Queens University of Charlotte

#### **Change in the Safety Measures in the Airline Industry**

The coronavirus pandemic has had a significant impact in the airline industry. Our research focused on the changes in the consumers attitudes towards the way people travel and airline health safety measure expectations during and after the pandemic. More specifically, the research investigates areas such as pre-flight screening for health safety, enhanced cabin cleaning, and amenities to see if customer preferences and needs have changed. The results of the study were designed to help the airline industry identify traveler expectations after the pandemic.

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**Student Authors (s):** Bradbary, Charles; de Boer, Anna; Daoudi, Mohammad; Newsome, Payton;

Queens University of Charlotte

**Mentors (s):** Cox, Steven; Queens University of Charlotte

#### **Food Network**

The Coronavirus had a major impact on our economy in recent months. In our research we wanted to find out how much of an impact the virus had on our online shopping behaviour since we had to refrain from in person shopping. Our focus was on online food delivery services. To investigate the situation, we developed a survey that was supposed to offer an insight in consumer's intentions. We asked research participants of their use of such services before, during and after COVID. Another focus of our research was what services they use and what factors were important in their decision to purchase food online. The results are designed to help online food delivery services understand the current market and what consumers are looking for in these times.

# Oral Presentations

## Chemical Sciences

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**Student Authors (s):** Renganathan, Nrithya; North Carolina School of Science And Math

**Mentors (s):** Anglin, Timothy; North Carolina School of Science And Math

### **Compatibility of Melamine Foams Hydrophobically Modified for Crude Oil Absorption with a Janus-Style Autonomous Propulsion Mechanism**

The need for crude oil remediation alternatives that are low cost, environmentally friendly, efficient and easily recoverable is increasing by the day, as oil spills have catastrophic effects on both water quality and ocean wildlife. This paper tests the compatibility of surface-modified hydrophobic melamine foams with a janus-style propulsion mechanism as a means of improving their efficiency and recoverability as an oil absorption method. Melamine, the base foam chosen for this preparation, has a high porosity that allows it to absorb many times its mass and a structure that is able to undergo hydrophobic surface modification through a facile and environmentally friendly dip-coating process inducing the self-assembly of tannic acid and n-octadecylamine. The janus-style, or asymmetric, loading of the foams with a camphor-based fuel propels the foam as it is gradually released through one end due to the difference in surface tensions between the fuel and water, as described by the Marangoni effect, effectively creating a smart device for oil absorption without external guidance. By applying video analysis techniques and measuring the degree and speed of oil uptake, it is seen that the attractive interactions of the loaded melamine foam induce movement towards other hydrophobic materials, leading to efficient on-the-fly oil absorption capabilities. This shows that the camphor-based fuel loading process onto hydrophobic melamine foams ameliorates their abilities as an oil absorption method, and will aid viability of the motors in practical remediation applications.

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**Student Authors (s):** Chen, Tianning; North Carolina School of Science And Math

**Mentors (s):** Anglin, Timothy; North Carolina School of Science And Math

### **Computational Design of Multi-Target AChE/NMDAR Ligands in a Merged Framework for the Symptomatic Treatment of Alzheimer's**

Alzheimer's Disease (AD) remains a highly prevalent issue as a greater proportion of the human population ages past 65, but no cures have been found. Preventative measures to date have failed to significantly impair the onset of AD, and all current FDA-approved treatments only target symptomatic relief. This study aims to enhance the therapy presently available by designing a dual inhibitor that would simultaneously antagonize both of the currently approved inhibitory targets: the acetylcholinesterase enzyme (AChE) and the N-methyl-D-aspartate receptor (NMDAR). The merged framework approach was utilized throughout the design process to conserve blood-brain barrier penetration and limit drug-drug interactions. Literature research was conducted to compile various inhibitors for each protein and computationally assess their pharmacodynamic and pharmacokinetic properties. The structures of the AChE inhibitors with the highest predicted binding affinities were integrated into the NMDAR inhibitor with the best predicted affinity, and vice versa. The majority of the new hybrids surpassed the original inhibitors affinity-wise, with compound H1 having the best balance of affinity and pharmacokinetic safety. Using various pharmacophore guidelines from previous hERG blockage studies, derivative D5 was designed and its risk of QT prolongation was estimated to be less than its parent compounds AP2238 and N8, as well as the FDA-approved Alzheimer's drug donepezil. Future work on modifying bifunctional drugs like D5 could lead to promising progress in alleviating the advance of Alzheimer's symptoms.

**Student Authors (s):** Belus, Narome; North Carolina Central University

**Mentors (s):** Christian, Omar; North Carolina Central University

#### **Isolation and Structure Elucidation of a Chromone Metabolites from *Hypericum Brachyphyllum***

Viral and bacterial infections continue to threaten human life and health, therefore, the search for natural products which can stem the tide of resistance and disrupt the looming pandemic has become a global initiative. Plants belonging to the Hypericaceae family, have been recognized as sources of flavonoids, xanthenes, benzophenones and chromones. These metabolites have displayed a wide range of biological activities such as anticancer, antibacterial, antioxidant, anti-HIV, and anti-inflammatory, and may hold the key to the next generation of druggable molecules to combat disease. In this study, the aerial parts of *Hypericum brachyphyllum* were examined. A novel chromone compound, with the molecular formula, was successfully isolated and identified using mass spectrometry as well as 1D and 2D NMR. Herein we discuss the isolation structure elucidation and preliminary biological evaluation of this metabolite.

**Student Authors (s):** Tran, Allison; UNC Charlotte

**Mentors (s):** Afonin, Kirill; UNC Charlotte

#### **Dehydration of Nucleic Acid Nanoparticles for Stable Storage and Transportation**

RNA therapeutics is an emerging field with Nucleic Acid Nanoparticles (NANPs) being a breakthrough development leading its frontline. NANPs are dynamic 3D nanostructures with highly modifiable physicochemical properties. They can accomplish a variety of biological applications with the ability to be functionalized with ligands ranging from cell-targeting aptamers to fluorescent tags. It is essential that NANPs retain their original structure throughout production, packaging, and shipment in order to ensure their practicality as a clinical tool. Dehydration of the samples is necessary due to the increased cost and destabilizing effects of shipping the samples in solution. Because of their likelihood of exposure to a wide variety of temperatures, there is a critical need to refine the preparation methods of NANPs. We propose two new techniques for drying NANPs: lyophilization and Light Assisted Drying (LAD). Lyophilization is a sublimation process in which pressure reduction is utilized as the main driving factor for removal of the solution. LAD is a recently developed innovation in which a near-IR laser is used to rapidly evaporate the solution. This technique allows for fine-tunable temperature controls, leading to distribution uniformity and more predictable results. LAD processes samples much faster while lyophilized samples retain the most structural integrity. Both methods show promising results with greater effectiveness than the traditional process of heat-drying samples in a vacuum concentrator. These developments are crucial in creating the optimal protocol for stable production, preparation, and shipment of NANPs, progressing their advancement towards usage in clinical applications.

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**Student Authors (s):** Wilkinson, Jake; UNC Asheville

**Mentors (s):** McMahon, Caitlin; UNC Asheville

### **Covalent Inhibition of Quorum Sensing in Biofilms**

Inhibition of biofilm formation by targeting quorum sensing is one way to fight infection and combat bacterial resistance. Quorum sensing is a process in which bacteria synthesize and secrete signaling molecules that trigger gene expression leading to biofilm formation once a concentration threshold is reached. The synthesis of one signaling molecule, autoinducer-2, is catalyzed by the enzyme LuxS, which is conserved throughout many species of bacteria. This reaction involves a cleavage of the natural substrate, S-ribosyl-L-homocysteine, into two different molecules. Exploring the possibility of using covalent inhibition to develop more effective, irreversible LuxS inhibitors, a derivative of the natural substrate will be synthesized by combining L-homocysteine with an electrophilic group to create a covalent bond in the enzyme binding site. A target inhibitor was synthesized by adding an  $\alpha,\beta$ -unsaturated carbonyl to the homocysteine moiety as the electrophilic group. The acid and amine of L-homocysteine were protected with a methyl and tert-butyloxycarbonyl group, respectively. Then, the alcohols of D-erythrone were protected as tert-butyldimethylsilyl ethers and the lactone was reduced. A Wittig reaction was performed on the resulting hemiacetal to form the  $\alpha,\beta$ -unsaturated carbonyl. This was then coupled to the protected L-homocysteine and all protecting groups were removed. LuxS enzyme will be purified from *E. coli* cells, and assays will be run to determine enzyme and biofilm growth inhibition. Computational docking was performed to predict the likelihood of covalent interactions between the inhibitor and active site residues and to inform synthesis of future inhibitors.

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**Student Authors (s):** Warlick, Hannah; North Carolina School of Science And Math

**Mentors (s):** Anglin, Timothy; North Carolina School of Science And Math

### **A Specific, Reversible pH-Activated Delivery System for the Identification of Malignant Brain Tumors**

pH-activatable agents, a recent development in MRI contrast agent research, have been demonstrated to allow greater insight into various physiological and disease processes than traditional contrast agents. However, challenges remain in creating agents with reversible activations for very specific activation thresholds, such as the difference in pH between healthy and cancerous brain tissue. Through computationally altering the electronegativity of a base containing 2,4,6 trimethoxybenzaldehyde-derived acetals, it is possible to develop a transport device that responds to a more specific range of pH reversible activation. This candidate was identified through intravenous CNS scoring of molecules with altered electronegativity and polarity, with a specific focus on the molecule's pKa and blood-brain barrier scoring. Future work aims to synthesize and test this candidate in the lab to provide further evidence of the candidate's viability as a more specific, pH-responsive reversible contrast agent delivery system. This innovation has a wide area of future applications, from the diagnosis and treatment of malignant brain tumors to bypassing invasive tissue biopsies for diagnosis.

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**Student Authors (s): Revelo, America; Forsyth Tech**

**Mentors (s): Russell, Travis; Forsyth Tech**

### **Extrinsic and Intrinsic Causes of Tooth Erosion**

The irreversible wearing away of the layers of the tooth, such as the enamel and the dentin, is called tooth erosion. This process results from a variety of factors, most commonly known and classified as either intrinsic or extrinsic, deriving from gastric juice or diet/environmental chemicals, respectively, but none involving bacteria. This research focuses on a two-week laboratory experiment, in conjunction with previously published research, to demonstrate the effect of these factors on the thinning of teeth and other health-related experiences. Selected chemicals are drinks from a daily diet and hydrochloric acid used to mimic the pH of gastric acid, tested on human teeth to calculate the erosion by measuring the change in mass, volume, and density of each. The hypothesis is that the existence of direct acids from a daily diet or direct acids from gastric juices in the medium of the oral cavity lead to dental erosion. The dominant explanation for the results is that the lower the pH of intrinsic and extrinsic factors, aside from others that affect teeth, play a significant role and prove that low pH or acidity is one of the causes of tooth erosion.

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**Student Authors (s): Karnley, Nathlita; Fayetteville State University**

**Mentors (s): Nagdas, Subir; Fayetteville State University**

### **The Role of the Mammalian Sperm Acrosome in Fertilization**

Mammalian fertilization is accomplished by the interaction between sperm and egg. Previously, we have identified a stable acrosomal matrix assembly from the bovine sperm acrosome termed the outer acrosomal membrane-matrix complex (OMC). This stable matrix assembly exhibits precise binding activity for acrosin and N-acetylglucosaminidase. A highly purified OMC fraction comprises three major (54, 50, and 45 kDa) and several minor (38–19 kDa) polypeptides. The set of minor polypeptides (38–19 kDa) termed “OMCrpf polypeptides” is selectively solubilized by high-pH extraction (pH 10.5), while the three major polypeptides (55, 50, and 45 kDa) remain insoluble. Proteomic identification of the OMC32 polypeptide (32 kDa polypeptide isolated from high-pH soluble fraction of OMC) yielded two peptides that matched the NCBI database sequence of acrosin-binding protein. The present study was undertaken to define the function of OMC32 polypeptide of the acrosome reaction, and to elucidate the potential role of the protein in sperm function.

**Student Authors (s):** Heintzelman, Daniel; Elon University

**Mentors (s):** Rizzuto, Anthony; Elon University

### **Kinetic Investigations of NO<sub>x</sub> Chemistry Pertaining to the Global Nitrogen Cycle**

Nitrogen containing compounds (NO<sub>x</sub> compounds) are of central importance to the global nitrogen cycle and the reactions in which they participate significantly impact many atmospheric processes and even influence global climate change. Despite this, the kinetic properties of many of the NO<sub>x</sub> reaction pathways remain incompletely understood. Of particular interest is nitrous acid (HNO<sub>2</sub>) and the multitude of atmospheric reactions in which it participates. Specifically, the rate of decomposition of HNO<sub>2</sub> under atmospheric conditions and in aerosol particles is largely unknown. This project aims to detail the kinetic processes involved in the decomposition of aqueous HNO<sub>2</sub> using UV-Visible spectroscopy. We show that the decomposition of HNO<sub>2</sub> occurs via both first- and second-order reaction kinetics, depending on the initial HNO<sub>2</sub> concentration in solution. This result implies the decomposition proceeds through two different mechanisms –a first order mechanism at low concentrations ( $\leq 0.01$  M) of HNO<sub>2</sub> and a second order mechanism at high concentrations ( $\geq 0.5$  M). The measured rate constants for the low and high concentration regimes were found to be 0.0029 min<sup>-1</sup> and 0.18 L·mol<sup>-1</sup> min<sup>-1</sup> respectively. Future studies will aim to elucidate the specific molecular mechanisms by which nitrous acid decomposes in the two concentration regimes.

**Student Authors (s):** Hall, Jonathan; East Carolina University

**Mentors (s):** Banerjee, Sambuddha; East Carolina University

### **Coping With Copper in Periplasmic FtrA**

*Brucella abortus* are Gram-negative, pathogenic bacteria that cause reproductive harm in cattle. It also can spread to humans via contacting, or consuming infected animals or dairy products, called brucellosis. In response to microbial invasion, the body naturally creates low pH pockets called macrophages, which trigger an efflux of divalent metals, such as Fe<sup>2+</sup> and Cu<sup>2+</sup>, causing unviability of microbes; however, *Brucella* thrive in low pH environments. Once inside the cell, the *Brucella* have iron utilization systems to acquire iron from the host. An important Fe<sup>2+</sup> transport system is FtrABCD, and we are currently investigating recombinant wild-type FtrA. In vivo experiments show that *Brucella* requires FtrA for the FtrABCD function. We have shown FtrA to have in vitro Cu<sup>2+</sup> dependent Mn<sup>2+</sup> (Fe<sup>2+</sup> mimic) binding. Since FtrA can only function when bound to Cu<sup>2+</sup>, we wanted to examine this protein's metal selectivity. Given that, *Brucella* has a Zn<sup>2+</sup> uptake system, the macrophages contain Zn<sup>2+</sup> ion, and that Zn<sup>2+</sup> ion can act as a mimic to Cu<sup>2+</sup>, we investigated the Zn<sup>2+</sup> affinity for wild-type recombinant *Brucella* FtrA. ITC data show that Zn<sup>2+</sup> has a ten-times stronger affinity for wild-type FtrA at pH 6.3 and binds to the protein in a 1:1 ratio (in contrast to 1:0.5 for FtrA and Cu<sup>2+</sup>). DSC experiments show that FtrA forms a non-native structural fold in the presence of these two metal ions. Zn<sup>2+</sup> being present in the periplasm of *Brucella* these in vitro data begs further in vivo experimentation investigating FtrABCD function in Zn<sup>2+</sup> background.

**Student Authors (s): Boyer, Nicholas; North Carolina School of Science And Math**

**Mentors (s): Anglin, Timothy; North Carolina School of Science And Math**

### **The Solubility of Cellulose in Ionic Liquids and Water**

Cellulosic ethanol is a renewable, alternative fuel that could reduce the reliance on fossil fuels. However, cellulose is resistant to breaking down into glucose because its crystalline structures make it inaccessible to catalysts in solution and this has prevented the widespread use of cellulosic ethanol. Ionic liquids have the potential for dissolving cellulose effectively to allow for catalysts to hydrolyze it for biofuels. This research investigated the solubility of cellobiose and cellopentaose in ionic liquids and water to determine what solvent conditions can best promote dissolution of cellulose. Molecular dynamics simulations were performed on ionic liquid solutions of 1-ethyl-3-methylimidazolium chloride ([EMIM]Cl), 1-butyl-3-methylimidazolium chloride ([BMIM]Cl), 1-ethyl-3-methylimidazolium acetate ([EMIM]OAc), and 1-butyl-3-methylimidazolium acetate ([BMIM]OAc). The methods for analyzing the efficacy of the solvents include center of mass distance between cellulose molecules, number of hydrogen bonds, number of interactions by solvent, rotational entropy, dihedral angles plot, ring angles, and radial distribution of the solvents. In addition, solvent shell models were made with two cellobiose molecules with a solvent shell and were minimized in energy to optimize the positions of molecules. The findings from these models suggest that ionic liquids are a superior solvent for dissolving cellulose. In particular, [BMIM]Cl appears to be the most effective solvent in dissolving cellulose based on the results from these models. The results from this research could lead to more research on cellulose solvents and use of solvents that optimize the hydrolysis of cellulose for biofuel production.

**Student Authors (s): Kolavennu, Shresht; North Carolina School of Science And Math**

**Mentors (s): Anglin, Timothy; North Carolina School of Science And Math**

### **Computationally designed spinal cord targeting nanoprobe using receptor-mediated transport to bypass the blood-brain barrier**

The treatment of central nervous system diseases in the pharmaceutical industry has been an ongoing problem due to a highly selective blood-brain barrier (BBB) which blocks the passage of many substances into the brain and spinal cord. This project computationally explored a targeted receptor-mediated drug delivery approach to pass the BBB with high efficacy and low toxicity to the body. This strategy involved selecting a targeting ligand that could cross the BBB, tethered to a PEG chain to reduce toxicity, which could then be tethered to a lipid molecule that forms a micelle capable of encapsulating a cargo drug. Several different drugs of the alpha-2 adrenergic drug class along with their PEGylated conjugations were tested on a computational alpha-2C adrenergic receptor and alpha-2BAR receptor using Molegro Virtual Docker. The binding affinities were recorded and as a result of these tests, clonidine has been shown to be the drug of choice as its PEGylated version blocks the induced effects of clonidine upon the body while likely allowing the clonidine to guide itself towards the alpha-2 adrenergic receptor. These results suggest that this clonidine-based design can be employed to treat Spinal Cord Injury (SCI) and other spinal cord diseases with high efficacy of drug administration.

**Student Authors (s): Bhadriraju, Anika; North Carolina School of Science And Math**

**Mentors (s): Anglin, Timothy; North Carolina School of Science And Math**

### **Computational Design of Pathogen-Specific Hsp90 Inhibitor to Target Malarial Parasites**

Malaria is a re-emerging disease that has become one of the leading causes of morbidity and mortality in the tropics. The demand for viable treatments for the disease has increased due to the parasite's resistance to conventional antimalarials, such as chloroquine, atovaquone, and artemisinin. The Heat Shock 90 (Hsp90) protein is critical to the normal growth and development in eukaryotes and specifically assists malarial parasites, such as *Plasmodium falciparum* (Pf), in surviving the sudden change between the two physiologically divergent habitats. This project dealt with the computational design of a pathogen-specific inhibitor that targets the *Plasmodium Falciparum* Hsp90 Protein. After examining the differences in conformation between the Pf and human Hsp90 orthologues, a Pf-specific hydrophobic pocket was located and focused on to improve selective binding to PfHsp90 over human Hsp90. Various target ligands were docked into both proteins using the Molegro Virtual Docker. Existing 7-azaindole compounds, such as IND311, and other established inhibitors, including PU-H71, were improved through computational screening to bind with high affinity to the ATP binding site of the protein while targeting the hydrophobic cavity found only in PfHsp90. The designed inhibitors, specifically Compound 13, were predicted to better bind to the Pf protein while showing lower binding affinity in the human orthologues, indicating the potential for parasitic inhibition.

**Student Authors (s): Allen-Perry, Kemryn; Fayetteville State University**

**Mentors (s): Autrey, Daniel; Fayetteville State University**

### **Trace Chemical Detection Using Intercalated MXenes as a Signal Enhancing Substrate**

MXenes are two-dimensional (2D) materials composed of layered transition metal nitrides, carbides, or carbonitrides and have similar electronic properties to graphene. It is hypothesized that Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> MXene may be a suitable support in surface-enhanced resonance Raman scattering (SERRS) for trace detection, with greater sensitivity and reproducibility. The SERRS spectra of Rhodamine B, excited at 532 nm, was measured on multilayer titanium carbide (ml-Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub>) nanosheets, which had been prepared by etching the Ti<sub>3</sub>AlC<sub>2</sub> MAX starting material with either a 30% mass hydrofluoric acid (HF) solution or in solution containing lithium fluoride (LiF) dissolved in 6 M hydrochloric acid (HCl). The Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> MXene nanosheets, prepared with the milder LiF/HCl etchant, showed a stronger enhancement effect of SERRS than did ml-Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> nanosheets which had been prepared using a harsher hydrofluoric acid (HF) etchant. It is proposed that the milder LiF/HCl method resulted in ml-Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> nanosheets with smaller interlayer separation which increased the occurrence of plasmonic hot spots. The more rigorous HF etchant process resulted in larger separation between layers and smaller particles. LiF/HCl etched nanosheets drop-cast onto a glass slide supported an approximately linear SERRS response from Rhodamine B over the concentration range 0.5- 5 x 10<sup>-6</sup> M. The linear concentration-dependence of the SERRS signal indicates that Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> would be suitable as a SERRS support for trace detection of analytes. Keywords: 2D materials, Mxenes, Titanium carbide, surface-enhanced, Raman, etchant

# Oral Presentations

## Communication & Journalism

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**Student Authors (s):** Cowan, Brittany; Chavis, Marshall; Cooper, Mia; Greene, Jazmine; North Carolina Central University

**Mentors (s):** Robinson, W. Russell; North Carolina Central University

**Behind the Lens of Hollywood: Functions of Diversity within the Writers' Room and Showrunners of Dramatic Television**

Within the creative spaces of dramatic television shows, the writers' and showrunners hold creative autonomy over the productions of said programs. Noting said observation, the writers' rooms of American dramatic television programming, socially construct a plethora of various incarnations of realities. The academic literature suggests that because of the lack of diversity within the writer's room of dramatic television programming, network television audiences, by de facto, are relegated to a rather homogeneous white washed lens of American popular culture. This exploratory study will examine the writing of three top American dramatic television series to measure the attempts of diversity and inclusion within the space of the writer's rooms and showrunners. To address this research challenge, this study will use a qualitative lens by way of a thematic analysis. The researchers will watch three episodes of the top rated dramatic television series across the traditional non subscription television landscape. From there, each episode will be coded per the operational definitions.

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**Student Authors (s):** Tyler, Isaiah; High Point University

**Mentors (s):** Ringel, Paul; High Point University

**Examining Mark Twain's Life on the Mississippi**

Mark Twain's autobiography, *Life on the Mississippi*, paints a picture of a vital method of transportation during his the pre-Civil War era, which greatly affected westward expansion. In this autobiography, we get insights into the life of a steamboat pilot navigating the Mississippi. Although this book follows Twain's time as a pilot, the importance of this book for American expansion and development of western commerce transcends the period in which it was published. This is especially important because the time of its publication, compared to the dates the events actually occur, are nearly 30 years apart. One potential reason Twain ventures back to give narration of events from his past is because of the impact that the events had on his personal development, even basing his pen name on a piloting term. The description of older events in his life also suggests simpler times as he talks about a pre-civil war era. We can also make sense of the gap in time because throughout the book Twain mentions his new appreciation for the river after piloting, stating that after piloting there was a certain beauty to the river that he lost, but he much rather have the pilots point of view. Twain's narration of the time period, and the steamboat industry which he mentions in elaborate detail, were critical to the growth, and spread of American civilization and western commerce. Steamboats created opportunities for all industries facilitating the movement of goods that was critical to America's economic and overall development.

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**Student Authors (s):** Suarez, Nani; Patterson, Dannel; Bryant, Ashaun; Floyd, Nakirah; North Carolina Central University

**Mentors (s):** Robinson, W. Russell; North Carolina Central University

**Constant Access To the Internet and the Impact on the Professional Development of Digital Native College Students**

As people become more dependent on technology, there is a necessity to investigate such behaviors. Contemporary college students represent the first generation of digital natives and will have a significant impact within the global economy. Historically, social skills along with strong professional development establish the core of a good leader. However, the inundation of technology does pose inherent risks, thus undermining a college student's potential for growth. This study will investigate the question of media dependency among digital native college students. A guiding question for this project, directly stated, are digital natives hampered in developing professional social skills due to constant social media saturation, will be addressed within this research. A mixed methodological research approach will be applied by way of survey data as well as in depth interviews to gain the student experiential perspective.

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**Student Authors (s):** Minter, Jordan; Hargrove, Chyna; North Carolina Central University

**Mentors (s):** Robinson, W. Russell; North Carolina Central University

**Social Justice From Inside The Bubble To the Anchor Chair: Reformation of Sports Journalist**

In August 2020, a 29-year-old African American man, Jacob Blake was shot by Kenosha police resulting in serious lifelong injuries. This in turn prompted players in NBA, and the world of sport for that matter, to take a stance for social justice, specifically, endorsing their support of the Black Lives Matter movement. In an attempt to raise the consciousness level of the NBA audience, not only did the athletes walk off the court for a period of time, but NBA sports analysts did so as well. Such was the case with Kenny Smith. He said, "As a black man, as a former player, I think it's best for me to support the players and just not be here tonight," NBA culture, already rocked, not just with the sudden passing of basketball phenom, Kobe Bryant, as well as the pandemic of 2020, the visceral killing of George Floyd by police created the perfect storm of an emotionally volatile season. Employing a case study methodology, this exploratory paper will examine how sports journalists executed their duties under such chaotic circumstances.

**Student Authors (s):** Meylan, Scott; Leach, Jalin; Kelly, Ja'va; Harris, Taylore;

**North Carolina Central University**

**Mentors (s):** Robinson, W. Russell; North Carolina Central University

**Blue and Red: A Comparative Study of Police Brutality Social Media Press Coverage Between Democratic and Republican States**

News media coverage of police brutality varies based on multiple factors. One factor to consider is a state's political affiliation as said agendas could potentially sway the media to cover a news story in a biased manner (Ladd, 2016). One only need look at the recent shooting of Jacob Blake; shot at point blank range in the back by Kenosha, Wisconsin law enforcement. It can be argued that various media outlets intentionally used pointed verbiage when describing the aftermath of the situation. Some media sources use the word 'protests' when discussing actions of people across the country. Other outlets call these acts 'riots'. Said terminology, as suggested by former CNN reporter Soledad O'brien, represents loaded words particularly as how they are used in the context of race and class. The focus of this study is to compare and contrast media coverage of police brutality cases in red and blue states, using the South Carolina shooting death of Walter Scott. Through a qualitative analysis of press coverage, this study will use critical race theory and agenda setting theory to address potential media biases which may occur.

**Student Authors (s):** Franks, Alan; Wilson, Daraka; Smith, Diajae; Foster, Jerome;

**North Carolina Central University**

**Mentors (s):** Robinson, W. Russell; North Carolina Central University

**Hidden Figures In A TV News Room: An Exploratory Study of Low Volume African American Missing Person Cases In North Carolina**

Over the past five years, television news press coverage arguably points to a racial bias in matters of coverage of African Americans as victims in missing person news stories. With African American children statistically representing the highest rates of missing person cases, nationally according to the NCIC missing person data of 2018, they often receive less volume in local and national press coverage. An example is easily evidenced in the case of Jayme Closs, a white victim of a high profile case of child abduction. Such was not the case with the disappearance of toddler Arianna Fitts and her mother Nichole Fitts, both African American. One explanation for this trend is a lack of diversity within television news stations. Previous researchers have relied on missing children statistics to find if, and or why African American missing children are significantly underrepresented in television news coverage. Min & Feaster, as well as Dixon & Linz compared how missing White Americans are overly represented in the mainstream press, sharply in contrast to African American victims. From their data, Min & Feaster, 80 % of missing person coverage is of White Americans while African Americans represent 20%. This leads to our research question; are missing African Americans considered newsworthy victims? This qualitative study proposes a critical examination into local television press newsrooms and the decision making process which play a part into the quality and quantity of the press coverage, in matters of race and class as it pertains to missing person and crime coverage in North Carolina.

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**Student Authors (s): Dowah, Siegee; McLaughlin, Ashley; Brown, Tanika; Stallings, Torreon;**

**North Carolina Central University**

**Mentors (s): Robinson, W. Russell; North Carolina Central University**

**The Performance of Mothering in Black and White: A Textual Analysis of Mini Series Little Fires Everywhere**

The concept of cultural motherhood discusses the challenges of inequality faced by mothers ranging from ethnicity, social class, and social norms projected by the media. The Celeste NG novel, *Little Fires Everywhere* explored the performance of motherhood. This novel was recently acquired and made into a television mini-series for Hulu. Our research will concentrate on the performance of motherhood, as it aligned with the hegemonic social construction of motherhood by way of mainstream media. For this investigation, the primary thesis rests on the contrast of how “mothering” is performed through the lens of race. This study, qualitative in nature, will result in a textual analysis, which will compare and contrast how motherhood is performed by the two lead protagonists. In keeping in the tradition of textual analysis, this project will additionally question how the producers/writers decode the constructs of class, gender, and race. To aid in our study, we will use a feminist theoretical lens employing the works of hooks, Rose, Lorde, and Hill-Collins.

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**Student Authors (s): Bunyan, de'ja; Bowman, Kristin; Johnson, Zaria; Greene, Amirah;**

**North Carolina Central University**

**Mentors (s): Robinson, W. Russell; North Carolina Central University**

**Sistas On The Gram: An Analysis of Instagram Use Among African American Women at an HBCU**

In 2010, Instagram became one of the newest social media content aggregators. Its sole purpose was to share photographs and 30 second video clips from the user. Since its launch, this specific platform became a topic of serious concern due to its appeal to adolescent girls. Social media researchers and others believed the new “selfie culture” due to the wide adoption of Instagram, perpetuated problematic issues related to self-esteem and the idealized body image. In a 2015 study, Kleemans and Daalmans concluded that exposure to idealized body images via Instagram led to more focus on the body and more uncertainty which led to total body dissatisfaction within their female participants. This study will focus on how Instagram impacts the emotional, and physical state of women of color at a Historically Black College University. This exploratory study will take a mixed methodological approach using a combination of survey data as well as focus group interviews, thus generating a thematic analysis to address the overarching research question, does Instagram have an impact on the psychological and physical states of the well being among African American female college students.

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**Student Authors (s):** Baysah, Assandra; Graham, Myles; Clark, Aireal; Weaver, Ovriona;

**North Carolina Central University**

**Mentors (s):** Robinson, W. Russell; North Carolina Central University

**From Sapphire to NeNe Leakes: An Exploratory Study on the Stereotypes of Black Women on Reality TV and the Impact on African-American Women at the HBCU**

According to contemporary literature in media studies, Black culture has been greatly impacted by reality television. A causal relationship between the stereotypes of African American women on these programs and the forward facing behavior of Black women in the real world is gaining traction in academic circles. Of these stereotypes, they perpetuate a gross generalization to the misconception of Black women being angry, unintelligent, and hypersexualized. Our research posits the question about the relationship between heavy exposure to reality television programming and behavior patterns of African-American female college students at an HBCU in North Carolina. The selected research method will consist of a mixed method approach: survey data as well as interviews to address the problem of the saturation of racial stereotypes presented within the landscape of reality television programming.

## Oral Presentations

### Computational Sciences

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**Student Authors (s):** Du, Melissa; North Carolina School of Science And Math

**Mentors (s):** Sheck, Amy; North Carolina School of Science And Math

**A versatile population dynamics model of antibiotic tolerance, persistence, and resistance**

In recent decades, there's been an alarming increase in bacterial evasion of antibiotic treatments, greatly necessitating an improved understanding of how antibiotic resistance, tolerance, and persistence evolve. These three phenotypes vary in their mechanism, with resistance conferring an increase in the MIC, or minimal antibiotic concentration required to inhibit bacterial growth, and persistence and tolerance both resulting in a prolonged MDK, or duration of lethal antibiotic application before bacterial death. While persistence confers temporary dramatic increases in MDK, tolerance has a milder permanent effect. A growing body of research has shown that tolerance and persistence drastically influence the evolutionary trajectory of a population, influencing not only the likelihood of resistance development, but also factors like mutation rate and response to stresses. To identify the specific influences of tolerance, persistence, and resistance on the survival and characteristics of a bacterial population, a theoretical model was created and analyzed. The results have shown that persistence plays a significant role in the survival of the bacterial population as a whole, while tolerance is more influential in the development of resistance. Although these functions are separately beneficial, both traits together exhibit mild antagonism. Additionally, there are antibiotic concentrations at which the bacterial population survives optimally, as well as concentrations at which the effect of tolerance is maximized. The specific insight into bacterial population dynamics offered by the model, which can easily be adapted to different bacterial strains and antibiotic treatments, will allow us to develop more individualized and specific strategies to combat bacterial diseases.

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**Student Authors (s):** Shah, Sandeep; North Carolina A&T State University

**Mentors (s):** Yuan, Xiaohong; North Carolina A&T State University

### **Implementing a Network Intrusion Detection System using Semi-Supervised Support Vector Machine and Random Forest**

Intruders always attempt to gain access to the network to perform malicious activities. So, the network security is an important aspect for any organization to keep their information secure. A Network Intrusion Detection System (NIDS) is an aid to secure the network by detecting abnormal or malicious traffic. In this paper, we applied a Semi-supervised machine learning approach to design a NIDS. We implemented semi-supervised Support Vector Machine (SVM) and semi-supervised Random Forest (RF) classifier to classify the NSL-KDD dataset. NSL-KDD is a benchmark dataset for network intrusion detection. We have classified the dataset in both binary and multiclass. Binary classification provides two classes – Normal and Anomaly. Whereas, multiclass classification provides five classes – Normal, DoS, Probe, R2L and U2R. We have also implemented a Genetic Algorithm approach to select the optimal features from the original features set. Then we compared the semi-supervised SVM and RF results containing all original features with the optimal features obtained after applying GA. Results show that the random forest algorithm produces a better result than SVM using semi-supervised learning method. Also, the results show that applying the GA in SVM produces a better result whereas the using GA in Semi-supervised Random Forest does not make a big change. We obtained the highest accuracy of 82% applying Random Forest with or without using Genetic Algorithm.

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**Student Authors (s):** Ackall, Gabriel; Elmzoudi, Mohammed; Yuan, Richard; Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)

**Mentors (s):** Tyler, Lori; Appalachian State University

### **An Exploration into the Detection of COVID-19 from Chest X-Ray Scans Using the xRGM-NET Convolutional Neural Network**

COVID-19 has spread rapidly across the world since late 2019. As of late September, 2020, there are approximately 7 million COVID-19 cases in the United States, which have caused businesses, schools, and government operations to shut down. The most common method of detecting COVID-19 is the RT-PCR swab test, which suffers from a high false-negative rate and a very slow turnaround of results, often up to two weeks. To complement swab tests, specialists can manually review x-ray images of the lungs to detect the presence of COVID-19 with up to 97% accuracy. Furthermore, neural network algorithms greatly accelerate this review process, analyzing hundreds of x-rays in seconds. Using the Cohen COVID-19 X-ray Database and the NIH ChestX-Ray8 Database, we trained and constructed the xRGM-NET convolutional neural network (CNN) to detect COVID-19 in x-ray scans of the lungs. To further aid medical professionals in the manual review of x-rays, we implemented the CNN activation mapping technique Score-Cam, which superimposes a heat map over an x-ray to illustrate which areas in the scan are most influential over the ultimate diagnosis. xRGM-NET achieved an overall classification accuracy of 97% with a sensitivity of 91% and specificity of 97%. Lightweight models like xRGM-NET serve to improve the efficiency and accuracy of COVID-19 detection in developing countries or rural areas. We hope that our model and methods will allow other researchers to create lightweight and accurate models as more COVID-19 x-ray scans become available.

**Student Authors (s):** Ambati, Yashas; North Carolina School of Science And Math

**Mentors (s):** Cheng, Qiang

### **Edge-enhanced Graph Convolutional Networks for Prediction of Autism Spectrum Disorder using Multi-modal Features**

In recent literature, graphs have emerged as a natural tool for modeling populations. In the context of disease classification, sparse graphs effectively incorporate imaging and non-imaging information. Specifically, nodes represent subjects and encode image-based features. Edges model associations between subjects and encode pairwise phenotypic similarity. Previous graph-based learning approaches encode phenotypic similarity as scalar edge weights. Unfortunately, this limits access to complementary information between phenotypic measures during the learning process. In this paper, we propose the use of Convolution based Edge-enhanced Graph Neural Networks for disease prediction. Using this method, we can represent a population as a sparse attributed graph. Here, we assign feature vectors, rather than scalar weights, to edges. Encoding the similarity of phenotypic measures as a vector preserves complementary information. The layers of the edge-enhanced network can learn predictive embeddings from both edge and node features. The model is trained on a partially labeled graph, aiming to classify the unlabeled nodes. The contributions of this study are as follows. We evaluate a new graph neural network model for disease classification. Moreover, we introduce a novel graph construction method that preserves the multi-dimensionality of phenotypic information. Finally, we investigate the influence of various phenotypic measures on classification accuracy. The proposed pipeline is evaluated on the ABIDE II dataset which is often regarded as the benchmark for autism research.

**Student Authors (s):** Liu, David; North Carolina School of Science And Math

**Mentors (s):** Bansal, Mohit; UNC Chapel Hill

### **Extending a Summarization Model with Pre-trained Transformers**

Recent work in text summarization combines the advantages of extractive and abstractive summarization. Abstractive models produce more concise summaries as they generate text from scratch. But, they suffer from slower encoding of long documents. Extractive models select salient sentences from the source documents as their summary. As a result, extractive approaches are often more efficient than abstractive methods. In Fast Abstractive Summarization with Reinforce-Selected Sentence Rewriting (Chen and Bansal), an extractor first selects salient sentences from the source text followed by an abstractor that rewrites the extracted sentences to generate a concise summary. The extractor first contains a CNN and bidirectional LSTM to encode the source text. The encoder is followed by an LSTM-RNN that trains a pointer network to extract sentences and decode the hidden states. The abstractor contains a simple encoder-aligned-decoder. By combining an extractive and abstractive approach, the paper achieved state-of-the-art results on the CNN/Dailymail Dataset. Recently, pre-trained transformers have shown success in text summarization tasks. The architecture also excels at representing the semantic relationships between words. Thus, we replace the traditional networks in the extractor's encoder with pre-trained transformers. We first re-implement the general structure of the model. This includes the extractor trained with reinforcement learning and an abstractor that operates on the extracted sentences. As for the module updates, we replace the encoder in the extractor with BERT encoders. Using BERT as the encoder in place of a CNN and LSTM combination increased ROUGE and METEOR scores.

**Student Authors (s): Jung, Sean; North Carolina School of Science And Math**

**Mentors (s): Heber, Steffen; North Carolina State University**

### **Template-Based Text Generation for Bioinformatic Figures**

We were interested in developing template-based text generators for figure descriptions of Bioinformatic figures to support the accessibility of the data to a broader audience. This text generator would describe pie charts, Venn diagrams, and curve charts that researchers may be interested in. In the field of text generation, there is more hope for creating text generators using neural networks over template-based models due to a repetitive nature that is often found in the text generated by template-based models. However, models that use neural networks require large data sets and were determined to not be viable for this project. Thus, the specific goal in the developed text generators was to create thorough descriptions of the figures that did not rely on the use of repetitive phrasing. In order to develop these text generators, figures and their respective textual descriptions were taken from bioinformatics papers and other sources. Different sections of the text were highlighted in order to detect patterns that were evident across all of the textual descriptions. The patterns that were discovered were then implemented in the text generators. We addressed the bias that could arise for the figure descriptions used to create the text generators by comparing the generated text descriptions against figure descriptions that weren't used to create the text generators. Future work for these text generators includes refining these text generators and the development of text generators for figures outside of pie charts, Venn diagrams, and curve charts.

**Student Authors (s): Liu, Jessica; North Carolina School of Science And Math**

**Mentors (s): Gladfelter, Amy; UNC Chapel Hill**

### **Image Analysis Pipeline of Septin Filaments**

Septin is a class of cytoskeletal protein found in all eukaryotic cells except plants. Septin polymerizes into filaments, which plays important roles in many cellular processes such as cell shape detection, ciliogenesis, bacterial infection defense, and cell division. Misregulated filaments can lead to cancer and neurodegenerative diseases, thus understanding the septin polymerization process is crucial. Despite their importance, septin polymerization is not widely studied, so analyzing filament fluorescence microscopy images under varying conditions could help better model the process. Five types of conditions are analyzed: WT low density, WT medium density, WT high density, gic mutants high density, and cla mutants high density. Individual filaments in each fluorescence microscopy image are detected using ImageJ Ridge Detection plugin then analyzed with Python. Two properties were specifically compared: bundling probability and local orientation alignment. Bundling preference, as calculated by fluorescence intensity, is found to be 1, 2, and 3 filament bundles for low, medium, and high density WT, respectively. Gic mutants adopt 2 filament bundles and cla 1. Local orientation alignment is measured by nematic correlation length, or distance at which the filaments are likely to be aligned. The low, medium, and high density WT have increasing nematic correlation length of 0.4, 0.9, and 1.3 microns, while gic and cla mutants have roughly the same nematic correlation length of 0.6. The image analysis pipeline used allows a basic analysis of septin features, and will incorporate more features in the future to help better understand the septin polymerization process.

**Student Authors (s): Sansom, Jayden; Chatham School of Science and Engineering; North Carolina School of Science And Math**

**Mentors (s): Dungan, Charlotte; North Carolina School of Science And Math**

**Artificial Intelligence as the Artist: Exploring the Capabilities of Artistic Perception Derived from Generative Adversarial Networks**

The question, “Can technology truly be creative?” has been debated for decades and even with continued research on the subject, a definitive answer has not yet been found. This research project is focused on the creation of paintings made from an Artificial Intelligence program. Beginning with forked code from Robbe Barren’s Deep Convolutional Generative Adversarial Network program and trained with images from the WikiArt online database, it has generated paintings in the two categories: portraits and landscapes. Then, students enrolled in an Art Appreciation course at Central Carolina Community College identified feelings, if any, from the viewed generated art, unaware that it is from the computer program. These results are able to show that computers are able to generate artistic pieces through creative processes that are capable of evoking human emotions.

**Student Authors (s): Thomas, William; North Carolina School of Science And Math**

**Mentors (s): Kleiner, Keethan; North Carolina School of Science And Math**

**Static Recompilation**

Among all the forms of emulation, none have remained as elusive as static recompilation. The notion of native execution of ROMs on a computer was an alluring prospect for the emulation community. In 2013, a student named Andrew Kelly wrote a blog post laying out his entire process of researching, implementing, and testing a static recompiler for the Nintendo Entertainment System. In his work he pointed out several flaws with static recompilation that make it less desirable than traditional emulation in most scenarios. One of the most crippling deficiencies is the lack of consistent indirect addressing. The compiler can’t track how the program runs in realtime, meaning these addresses can’t be updated. This led many to determine that static recompilation couldn’t be viable, but I decided to take a different approach. Static recompilation in a pure form may not work, but this could be solved by creating a table that would store jumpable addresses and their values as the program progresses. I created such a table, and was able to successfully read and jump to addresses as they changed in real time, however this led to the emergence of an entirely new problem. Each NES ROM had an entirely unique address space, and although there were certain patterns common amongst developers, attempting to create a one-fits-all recompiler with compatibility to match would be impossible. Although there is proof of a functioning highly-compatible static-recompiler, it simply takes too much work to justify the results compared to the excellent emulators already available.

**Student Authors (s):** Nair, Nina; North Carolina School of Science And Math

**Mentors (s):** Bruno, Michael; North Carolina School of Science And Math

### **Computational Design of a Dual Topoisomerase II/Hsp90 Inhibitor for Cancer Therapies**

Due to their important roles in cell proliferation and survival, Heat Shock Protein 90 (Hsp90) and Topoisomerase II (Topo II) are two well studied protein targets in the development of anticancer drugs. While functionally unique, Hsp90 and Topo II share structural similarities in their ATP binding sites and have been shown to form a transient complex. The development of a dual inhibitor could eliminate undesirable drug interactions while simultaneously targeting both protein pathways. PU3 is an Hsp90 inhibitor that demonstrates potential as a candidate for targeting Topo II. While a promising candidate for dual inhibition, PU3 displays low solubility making it a poor drug candidate. Hence, this study proposes a novel small molecule Hsp90/Topo II dual inhibitor that has the potential to improve the inhibition and oral administration efficacy of PU3. The dual inhibitor was designed by modifying PU3, the suggested pharmacore, using ChemDraw. StarDrop scoring profiles were considered in determining the generated compounds suitability for oral administration. The binding affinities of the selected compounds to Hsp90 and Topo II were predicted using the Molegro Virtual Docker. After analyzing the binding affinities and pharmacokinetic/dynamic scoring profiles, a novel compound was determined as the best candidate for Hsp90/Topo II dual inhibition, demonstrating a greater binding affinity to both Topo II and Hsp90, as well as a higher Oral Non CNS Score than PU3. The proposed ligand demonstrates promise as a potential orally administered novel dual inhibitor that can act synergistically with other forms of cancer therapy.

**Student Authors (s):** Motteler, Sarah; North Carolina School of Science And Math

**Mentors (s):** Kleiner, Keethan; North Carolina School of Science And Math

### **Research into Java User-Based Recommender Systems**

In my research, I developed a user-based recommender system that compared the predicted ratings generated by the program to the actual ratings. Recommender systems are programs that attempt to predict the rating that a user would give to a certain item; they are mostly used commercially. These recommendations can be calculated in several ways, the most common of which are the user-based approach, which compares similar users to calculate ratings, and the content-based approach, which compares similar products to calculate ratings. I created a Java algorithm that compared a predicted rating for a specific user and movie to the actual rating that user gave to that specific movie. The predicted rating was calculated by averaging the ratings that all “similar” users gave to the specific movie (“similarity” was found by whether or not another user rated at least one film similarly to the specific user). I found that despite the fact that the program only got the rating correct a few hundred times out of about thirty-five thousand entries, the error was found to be centered around zero. Although I did not draw any major conclusions from my research, I found several ways to expand my research in the future, such as modifying my algorithm to become a hybrid approach or to use positive-only feedback or narrowing the “similar” users down by requiring more similar ratings to be considered “similar”.

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**Student Authors (s): Mohsin, Abir; North Carolina School of Science And Math**

**Mentors (s): Bruno, Michael; North Carolina School of Science And Math**

**Synthesis of a Novel Insecticide to Target 5-HT<sub>2a</sub> Serotonin Receptors in *Drosophila melanogaster***

While vertebrate and invertebrate serotonin receptors have a very similar structure, the pharmacological effects between both receptors have been shown to differ. Some synthetic agonists for human serotonergic receptors have been shown to have less potency and efficacy on insect serotonergic receptors. This warrants investigation into serotonin targeting insecticides as new novel insecticides targeting invertebrates with potentially low-risk to humans. This project aims to computationally analyze the human and *Drosophila melanogaster* 5-HT<sub>2a</sub> receptors to create derivatives of a known 5-HT<sub>2a</sub> agonist, methiothepin, and take the best binding derivative and test its effects on *Drosophila* in vivo. The Phyre2 Protein Modeller was used to generate a possible predicted secondary structure of the yet-undetermined *Drosophila* 5-HT<sub>2a</sub> receptor. I analyzed both 5-HT<sub>2a</sub> receptors to find active binding sites and then docked various ligands, then analyzed for binding affinity by Molegro Data Modeller. Methiothepin was predicted to bind equally well to insect and human serotonin receptors. The *drosophila* 5-HT<sub>2a</sub> receptor has a 39% identity conservation with the human receptor. In *Drosophila*, Leu228 is replaced with an Arg. We made targeted modifications to methiothepin to improve interactions with the Arg and discourage interactions with the Val to develop a molecule that could preferentially bind to insect 5-HT<sub>2a</sub> receptors over the human counterpart to produce an insecticide with less toxicity to humans. Successful compound derivatives had undergone organic transformations to add electron-donating functional groups to the structure of methiothepin to better interact with residue Arg443 in the *drosophila* receptor.

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**Student Authors (s): McGinnis, Cliff; North Carolina School of Science And Math**

**Mentors (s): Bruno, Michael; North Carolina School of Science And Math**

**Chemically Modifying Ivacaftor for Better Oral Administration**

Cystic Fibrosis (CF) is a respiratory disease that results in a buildup of mucus due to blocked ion channels. Ivacaftor is a drug that helps potentiate the CFTR ion channels and keep them in the open position, specifically in the G551D mutation of the CFTR, which accounts for approximately 5% of patients diagnosed with CF. The aims of this project are to make targeted modifications to Ivacaftor. To accomplish this, the NOVA tool from Stardrop was used to generate new compounds. Scoring profiles were considered in determining the generated compounds' suitability for oral administration. The binding affinities of the selected compounds to G551D CFTR were predicted using the Molegro Virtual Docker. Compounds with the most improved oral non-CNS scores, as well as an improved logS, resulted from polar modifications to one or both of the tert-butyl functional groups on the benzene ring or by changing the aromatic double ring structure to a pyrrole. The best overall candidates were examined and assayed for potential improvements in binding affinity.

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**Student Authors (s): Ketola, Austin; North Carolina School of Science And Math**

**Mentors (s): Dawson, Hunter;**

### **Techno-Economic Analysis of Surgical Guides**

One specific use of three-dimensional (3D) printing is the production of drill guides assisting in dental implant placement, which are custom-fit to each patient. They allow doctors to place implants at the correct angle and depth that allows for better restoration and less nerve damage. Compared to previously used subtractive manufacturing methods, these guides are more durable, more accurate, and lower cost. Three methods of production are analyzed in this study, including outsourcing, in-house, and a hybrid model. Outsourcing involves a doctor sending scans of a patient's teeth to a third-party vendor and they produce and mail the finished guide, in-house involves manufacturing the guide from start to finish locally, and the hybrid model involves using a third-party vendor to virtually plan and design the guide and then locally print it. This study takes data from a company that has worked with each model and calculates the predicted cost per guide with each production method. According to these predictions, producing the guides through outsourcing is by far the most expensive but requires the least amount of work from the receiving dental practice. Using either the hybrid or in-house model results in a significantly lower cost compared to using outsourcing with a 47% lower predicted cost and predicted savings of around \$125,000 over 1,000 guides. Each development model possesses its own advantages and disadvantages and each practice can choose the one they believe to be the best fit.

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**Student Authors (s): Dadi, Shrihan; UNC Wilmington**

**Mentors (s): Chen, Cuixian; UNC Wilmington**

### **Impact of Dimensionality Reduction for Age Estimation and Gender Classification of the FG-NET Database**

The FG-NET database was one of the first databases to be made publicly available for research in the fields of age estimation, age progression, and gender classification. The primary challenge using FG-NET comes from the fact that the database only contains 1002 images, which can result in suboptimal results for models and classifiers. One of the main problems in the field of face recognition is high dimensionality, so dimensionality reduction techniques are important to use for reducing variability and collinearity. We studied age estimation and gender classification by creating and testing various regression models and classifiers using extracted facial features (from the Active Appearance Model). Then we reduced the database to 10, 25, and 50 dimensions via principal component analysis (PCA) and kernel principal component analysis (KPCA). By using PCA (for both age estimation and gender classification), we reduced the FG-NET database to 50 dimensions while maintaining the same level of mean absolute error as models that used all 109 dimensions. KPCA did not produce results as good as PCA did but performed similarly on very low dimensions.

**Student Authors (s):** Brewer, Ethan; North Carolina School of Science And Math

**Mentors (s):** Koberstein, Nicholas; North Carolina School of Science And Math

#### **Strategy Analysis of the Mesopotamian Royal Game of Ur**

The Royal Game of Ur is a recently rediscovered ancient Mesopotamian two-player board game where victory is achieved by the player that moves all of their pieces to the end of the board first. By developing a computational model to simulate players and the game environment, our team was able to compare a class of strategies against each other in statistically significant sample sizes. After running a round-robin tournament among ten agents that each moved their furthest piece, rather than the closest piece, with ten percent higher likelihood than the last, we identified a prevailing strategy, significant biases in win rates towards players due to player order, and how those biases were affected by different strategies. Our model yielded a decisive conclusion: moving the farthest-along game piece is a dominant strategy over the closest piece.

**Student Authors (s):** Yuan, John; North Carolina School of Science And Math

**Mentors (s):** Bruno, Michael; North Carolina School of Science And Math

#### **Discovery of new Janus Kinase 1 Inhibitors for Rheumatoid Arthritis Treatment through Docking and Molecular Dynamics Simulations**

Rheumatoid arthritis (RA) is a chronic inflammatory disorder that primarily affects joints caused by the immune system mistakenly attacking the lining of joints. An emerging method of treatment of this illness is through the use of Janus Kinase (JAK) inhibitors that inhibit the cytokine signaling in the Janus Kinase subgroup, which is in part responsible for the dysfunctional immune system. Previous work has identified three traditional Chinese herbal medicines, icaritin, cyrtostansione, and indirubin, as potential JAK3 inhibitors. In this work, these three molecules were docked into the active site of JAK1 (3EYG), using Molegro Virtual Docker and the best-docked poses were examined for their binding affinities. We determined that icaritin had the best binding affinity to JAK1, possibly owing to its quercetin base structure. Multiple modifications were made to the molecular structure of icaritin to improve binding affinity. Certain modifications were able to produce ligands which had significantly improved binding affinity in comparison to the parent icaritin. Further substructure searches resulted in the discovery of the potential of pachypodol, a plant-derived quercetin, to act as a JAK1 inhibitor comparable to upadacitinib, one of the most potent JAK1 inhibitors. These discoveries are expected to provide directives for further synthesis of highly effective JAK1 inhibitors.

# Oral Presentations

## Cultural & Language Studies

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**Student Authors (s):** Gates, Kayla; Chowan University

**Mentors (s):** Hayes, Timothy; Chowan University

### **Tennyson's Exploration of God and Grief**

The process of grief is known to be one of the hardest and most questionable times of an individual's life. A human goes through many phases and stages of grief including denial, anger, bargaining, depression, and acceptance. Although grief is not discussed often, it is a long journey of emotional confusion that never seems to end, and in a way, it does not end. People only learn to cope with the feeling and simply just deal with the loss of a loved one, but those sad feelings never seem to subside. A surfeit of these phases of grief are vividly depicted in Alfred Lord Tennyson's *In Memoriam A.H.H.*, and it is a melancholy, rollercoaster of grief and acceptance for the reader to experience. Tennyson uses his poetry to help him during his tough journey with grief and his detrimental crisis of faith, and it is shown in three key points in the text.

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**Student Authors (s):** Bentley, Jakera; Fayetteville State University

**Mentors (s):** Buckner, Timothy; Fayetteville State University

### **Adult Second Language Learning**

When it comes to second language acquisition adults tend to have more problems than children do. It isn't impossible for adults to learn a second language (L2) it is just a lot harder when compared to when they learned their first language. The reason for this difficulty can not only be seen when looking at an adult's brain but also by looking at how society feels about multilingualism. The brain begins to lose its plasticity, as it gets older and because there is no societal pressure to learn a second language it becomes trivial. It can be said that "it is possible that there is a critical period for first but not for second language acquisition". This would naturally make it more strenuous when adults would try to learn their second language. Since it is tough for adults to learn a second language some instead just cope with the fact that they won't fully learn the language. They do this by learning the language imperfectly, developing a pidgin or creole, or developing a lingua franca. The adults who still try to learn a second language instead of using those coping mechanisms may use mobile-assisted language learning (MALL). Two popular MALL apps are Babbel and Duolingo. People started using these apps because of how flexible mobile learning is when compared to traditional classroom settings. These apps promise to help the user learn another language. There have been multiple studies done on both apps that show that they are effective.

**Student Authors (s):** Martinez, Mackenzie; Elon University

**Mentors (s):** Carroll, Jennifer; Elon University

**The Rituals of Womanhood: An Autoethnographic, Cross-Cultural Study of Female Coming of Age Ceremonies in Jewish and Latinx Cultures**

For decades, anthropologists have been exploring the ways in which societies celebrate the transition from childhood to adulthood, particularly for young women. To better understand the importance of these ceremonies and their cultural roles, this study examines two such rituals: Bat Mitzvahs and Quinceañeras. Through key informants at local places of worship in central North Carolina, the researcher conducted nine interviews with girls between twelve and sixteen who had one of these ceremonies. The findings show that coming of age rituals are of greater importance in an American context where religious and ethnic minorities are faced with a loss of cultural identity and practices due to assimilation. While the two celebrations are distinct in the way that the young women prepare for them and the importance given to each aspect of the event, they share many values such as cultural preservation and definitions of womanhood. This study adds to the growing body of literature surrounding coming of age rituals and uniquely analyses the cross sections of two distinct cultures.

## Oral Presentations

### Education

**Student Authors (s):** Tothorow, Devin; Polaski, Katherine; Meredith College

**Mentors (s):** O'Keefe, Amy; Meredith College

**Fostering Online Classroom Communities through RTTP and Slack**

Relationship ties in the classroom, whether they be friendships or acquaintanceships, are key to fostering an effective classroom community. With the onset of the COVID-19 pandemic in early 2020 many universities worldwide have had to make the switch to online learning. Now more than ever teachers need tools and strategies to foster classroom community in online settings. The rising popularity of immersive and engaging historical role-playing games such as Reacting to the Past (RTTP) led previous researchers to study how RTTP games affected the classroom community (Webb and Engar 2016). Previous research was done in a face-to-face (F2F) setting; our study replicated the 2016 study in an online setting. Our study wanted to determine if RTTP did help build friendship and/or acquaintanceship networks between students and if network formation in online settings works differently from F2F settings. Our study also aimed to provide instructors with information on what barriers are present (or what barriers students perceived) to network formation and building an effective classroom community in an online setting. For this reason, we collected both qualitative and quantitative data in the form of a set of three surveys distributed to an online class at set points in the summer term, observations of the online class, and a separate survey sent out to spring semester students. From this data, we created network visualizations that showed significant growth in student relationships over the summer term RTTP class. Students expressed appreciation for platforms like Slack that provided opportunities for informal student-led interaction.

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**Student Authors (s):** Casner, Megan; Elon University

**Mentors (s):** Lake, Danielle; Elon University

**Elon By Design: Assessing Elon's Design Thinking Ecosystem**

The Design Thinking (DT) program at Elon University launched in 2016 with a studio pilot program. The initiative has recently expanded with the addition of Dr. Danielle Lake as program director. To date, the program has facilitated over 120 workshops serving over 2,000 students. The purpose of this project is to assess and explore the DT ecosystems present at Elon University focusing on the various ways that faculty members utilizing DT in their courses and the different facets of their use of DT practices. The project assumed a mixed-methods approach, incorporating quantitative and qualitative components. The quantitative component was made up of a survey of 35 faculty members, who incorporate DT practices into their courses, about the perceptions of DT and their experience of utilizing DT in the classroom. These faculty members were from different, academic disciplines and possessed varying levels of experience with DT. The qualitative component consisted of a series of semi-structured, follow-up interviews with 34 of the faculty members, who participated in the initial survey. The faculty's responses were compared across academic discipline and levels of experience with DT. The researchers found that faculty's perceptions and understanding of DT was driven by their academic disciplines, and faculty members integrated DT into their courses in similar ways citing similar benefits gained from and challenges that they faced due to the implementation of DT practices across academic disciplines experience levels with DT. From these findings, the researchers offer recommendations to other institutions that may be interested in similar programs.

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**Student Authors (s):** Simmons, Heather; High Point University

**Mentors (s):** Vess, Sarah; High Point University

**Causes Leading to the Misdiagnosis of English Language Learners**

English Language Learners (ELLs) are one of the fastest growing student populations in the United States. Those of which are entering into an education system that doesn't fully understand their challenges. With the influx of students entering the U.S. varying on every front from language to life experiences, a one size fits all approach will not be enough. The current system leads to a multitude of problems for the English Language Learner, including a misdiagnosis and qualification for special education. The problem of ELLs being misdiagnosed as a Student With a Disability is a multifaceted problem, one of which a direct cause cannot be pointed to. Whether that be in regards to how to prepare teachers to understand their learning needs, cultural biases in the curriculum or personal biases they may lay unchecked, all are dangerous to decisions being made about the student. This presentation will discuss the possible causes leading to misdiagnosis.

**Student Authors (s):** Pereira, Sasha R.; North Carolina State University

**Mentors (s):** O'Leary, Scott; North Carolina State University

### **Honors outreach as an integrator of academic preparation and leadership development**

Higher education provides abundant opportunities for personal and professional growth, but many prospective students face social and class barriers to entry. Although the number of first-generation and low-income students has increased in the last 30 years, the progressive nature of higher education is confronted by the more deeply entrenched problem of “undermatching,” in which students from underrepresented backgrounds do not attend or apply to programs as selective as their credentials might warrant (Hoxby & Avery, 2012). Recent research suggests that undermatching is neither about ineffective recruitment tactics nor a lack of information, but rather involves the inability to see oneself as a high-achieving college student (Gurantz et al., 2019). As proponents of equity in education, this has led many collegiate Honors programs to build relationships with community partners who support and work closely with underrepresented groups. While recruitment and retention initiatives increase representation among first-generation and low-income backgrounds, a complementary approach aimed at outreach to students earlier in their academic journeys can help students see themselves as college-bound and high-achieving, and provides academically enriching experiences for current Honors students. Leadership, Engagement, and Academic Preparation (L.E.A.P.) is a holistic outreach initiative created by the NC State University Honors Program that provides underrepresented high school students with an opportunity to experience college life years prior to deciding their post-secondary plans. This presentation uses L.E.A.P. as a case study to consider the importance of Honors outreach in addressing undermatching and start larger conversations on best practices for inclusive outreach efforts in higher education.

**Student Authors (s):** Higgins, Katelyn; North Carolina State University

**Mentors (s):** Stevenson, Kathryn; North Carolina State University

### **Intergenerational Learning: Youth Leading Their Communities**

The environmental issue of marine debris threatens our coastal ecosystems (Riggs, Ames, Culver, & Mallinson, 2011). Although multiple technical solutions have been presented to address this challenge, success hinges on broad backing from a scientifically and environmentally literate citizenry (Roth, 1992). Educating children may present an opportunity to combat marine debris now and into the future. Research shows that child-focused education can help children build concern about environmental issues, and they in turn can engage the adults in their lives through conversations (Lawson et al., 2019). This poster presents emerging results from an undergraduate-student led qualitative study exploring adults' perspectives on the mechanisms under which children may influence them. The study setting for this research was North Carolina adults that participated in a youth-led community engagement event on the topic of marine debris. This study used interviews of local community adults and local officials to examine their personal perceptions of the level of student influence in their communities based on the Town Hall meetings. Eighteen interviews have been conducted thus far in an ongoing study, and the emerging results indicate that the adults believe youth are inspiring, want to support youth, and believe that youth bridge barriers to action. This study aims to support that environmental education for young people on pressing environmental issues can make a positive difference now, creating a generation of children committed to environmental protection and inspiring community adults to go where their local youth are boldly leading them.

**Student Authors (s):** Graham Crystal; Fayetteville State University

**Mentors (s):** Mills, Brad; Fayetteville State University

### **Suspension Rate of Students in Special Education**

The focus of the research project was to examine the rate of suspension from school for students with disabilities compared to their non-disabled peers. There are a high percentage of students with disabilities who get suspended from school. There are numerous reasons why students with disabilities get suspended such as, poor communication skills from students and teachers, gender/racial profile, and student frustration (not being able to explain themselves). Students are usually suspended based on their behavior problems and acting out (i.e., fighting or being disruptive). Analysis found a statistically significant positive correlation between the total number of suspensions for students with disabilities and the number of suspensions for students with Emotional Disturbance based on state-level data.

**Student Authors (s):** Dodson, Alesia; Fayetteville State University

**Mentors (s):** Okunbor, Daniel; Fayetteville State University

### **An in-depth Analysis of Flipped Pedagogy in STEM Learning at an HBCU**

Flipped classrooms are learning interventions that restructure the way a student attains materials. A typical traditional learning course devotes most of the class time to delivering information, and thus spends minimal time in teaching how to apply information learned. A flipped class utilizes all available time through pre-constructed video lectures that are administered to the students before class. Teaching the course materials outside of class allows teachers to focus on application and understanding of key concepts. Students are engaged in active learning through group learning and practical problem solving. Student perceptions of this pedagogy are mixed because they find it difficult to adjust their current learning routine to a more demanding, time consuming teaching style. Studies on flipped pedagogy have been conducted worldwide at large institutions, but there is a gap in the research because of the lack of exploration of flipped courses at Black Colleges or Universities (HBCUs). The purpose of this study is to determine the cognitive performance, and perception of students in flipped courses. Fayetteville State University (FSU) conducted the study in three Student-Centered Active Learning Environment with Upside-down Pedagogies (SCALE-UP) classes using focus group research. The focus group consisted of eight students from the computer science, biology, pre- calculus, and chemistry flipped courses provided at FSU. They participated in the focus group via Zoom. The perceptions of the flipped courses were positive with all students claiming they would enroll in a flipped course in the future. The students also suggested interactive activities that would improve upon the current flipped curriculum and commented on the techniques and activities that were effective in teaching key course concepts. \*Research was supported in part through grants from National Science Foundation Historically Black Colleges and Universities Undergraduate Programs (HBCU-UP, Grant Award No. HRD-1719472) and the U.S. Department of Education McNair Post Baccalaureate Achievement Program (Award No. P217A170138).

**Student Authors (s): Childs, Myah; Davis, Theresa; Speaks, Khayla; Harper, Isaiah; North Carolina A&T State University**

**Mentors (s): Webb, Jared; North Carolina A&T State University**

### **This is Us, By Us: The impact of undergraduate research within STEM education**

Prior research has shown the positive implications of undergraduate students' research experiences; however, these opportunities are often lacking for undergraduate students in STEM education, particularly Black preservice teachers aiming to teach STEM to young children in elementary school. In this study, we investigate the importance of these research opportunities as part of a broader NSF-funded research study focused on exploring and shaping the mathematics identities and visions for mathematics teaching of future Black teachers. Drawing from interviews and autoethnographies, we collected the rich perspectives of four future teachers who are also serving as researchers on an equity-focused STEM education research study. We used case study methods to analyze similarities and differences among these researchers' experiences. Findings indicate that research experiences impacted these researchers' mathematics identities and visions for mathematics teaching in several ways. First, justice-forward undergraduate research experiences contributed to a deeper understanding and appreciation of the complexity of research in STEM education. Second, these experiences shaped their vision for mathematics as a domain of learning and mathematics education as a space to frame social justice issues using mathematics. Third, these experiences opened possibilities for a new community of practice - a collection of intellectually gifted, Black preservice teachers, from which they are able to de/reconstruct their mathematics identities and subsequently construct new visions for mathematics teaching. Collectively, these results highlight important aspects of the power of undergraduate research experiences in STEM education and its implications on future teachers' mathematics identities and visions for mathematics teaching.

**Student Authors (s): Braisa White; Wingate University**

**Mentors (s): Clemmer, Brandy; Wingate University**

### **Effective Instructional Behaviors in Athletic Training Clinical Education**

"Clinical education" refers to programs that provide developing professionals with practical and skills-oriented instruction under the supervision of a skilled practitioner, and is the groundwork for many medical professions. Effective institutional behavior demonstrated by the preceptor is the foundation to quality clinical education, which includes instruction from preceptors as well as a cooperative relationship with the student. Active listening and engagement, proper communication, trust, and educational investment between preceptor and student that allows the student to feel that they are getting the most out of their clinical experience. The relationship between student and preceptor is one that can positively or negatively influence a student's education in a major way: therefore, the presence of active listening, encouragement and educational investment, specifically, are key in the installation of student confidence which translate into their medical profession, along with clinical sites. This study compared effective clinical instruction based on preceptor-student relationships that possess traits such as educational investment, active listening and encouragement. Data from the Leadership in Clinical Education survey was utilized to determine the presence of significant differences between clinical sites. ANOVA tests were run to compare clinical sites and effective clinical instruction qualities from preceptors. The results of this study displayed no significant differences in clinical instruction provided at various clinical settings. Therefore effective clinical instruction does not vary at most clinical sites and is dependent on the preceptor. The results of this study will build a framework for preceptor selection and training as it relates to effective instructional behaviors.

**Student Authors (s):** Boston, Jhana; North Carolina Central University

**Mentors (s):** Jackson, Karen; North Carolina Central University

### **The Miseducation of African American Students in the American Education System**

Children go through many developmental struggles in the school system, but the American education system needs to be assessed on its approach to teaching Black students. The ones with the most significant impact on these children's lives, after their parents, are their teachers and administrators. However, it is unclear if African American children are truly being supported and prepared with the current education system or if it is just a part of a larger oppressive construct. Being that education provides the building blocks to students' adult lives, it is important to reevaluate the structure of the education system and determine if it is lacking a foundation for African American students. There are many flaws in the education system that bring to question its ability to provide the proper environment for intellectual growth. Are standardized tests truly reliable and accurate? Do Alternative Learning and Special Education programs help students with learning disabilities or are they a ploy to segregate students? Lastly, how impactful is representation in the classroom? I've explored these questions and it is apparent from the research that the American education system is lacking appropriate support for African American students by limiting their abilities through alternative learning placements and a lack of multicultural educators. These factors may contribute to their negative performance on standardized tests and sometimes low motivation. Thus, I argue that a variety of teaching methods and assessment practices along with an increase in diversity amongst K-12 teachers is needed to better reach all students.

## **Oral Presentations**

### **Engineering**

**Student Authors (s):** May, Kylee; North Carolina State University

**Mentors (s):** Palma Parra, Ariadne; North Carolina State University

### **The Effect of Critical Angle Variability on Maximum Displacement Discrepancies in Bridge Columns**

Earthquakes have proven over the years to be a complex phenomenon and have created quite a challenge for structural engineers. Upon the release of energy during an earthquake, the resultant seismic waves lead to ground motion. Response spectra represent the peak responses of all possible structures under ground motions and are used in seismic design. Past research has found that there is variability between expected and actual peak displacement values of bridge columns under ground motion. One possible cause of this variability is the discrepancy between the angle at which the predicted response occurs and the angle at which the actual response occurs. Displacement response data from a group of 21,000 columns under ground motion will be taken to identify the actual angle corresponding to the maximum response, known as the critical angle. The critical angle of the predicted response is found from the response spectra used in the design process. The ratio between the predicted and actual critical angles will then be related to the ratio of expected to actual maximum displacements. It is being hypothesized that the variability between predicted and actual critical angles can be used to explain the discrepancies between expected and actual displacements of a structure that experiences permanent deformation, known as an inelastic structure. By understanding the relationship between the critical angle ratios and the maximum displacement ratios, it may be possible to advance the knowledge of how structures respond under earthquake loading.

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**Student Authors (s): Barre, Emily; Duke University**

**Mentors (s): Trahey, Gregg; Duke University**

**Developing a Region of Interest Selection Method for Automated Implementation of the ALARA Principle in Fetal Ultrasound**

FDA guidelines suggest that ultrasound exposure should follow the ALARA (As Low as Reasonably Achievable) principle. Adherence to the ALARA principle is largely user-dependent and several studies indicate that compliance is lacking. Our goal is the development of a rapid, automatic technique to achieve ALARA. Our previous work has shown that monitoring image quality as transmit power changes can be used to determine an optimum Mechanical Index (MI) for an ultrasound image. In this framework, Lag One Coherence (LOC) is assessed from images collected at varying MI values, a sigmoid function is fit to the LOC v. MI data, and the point where the LOC reaches 98% of its maximum is considered the optimum MI. While our results indicate that LOC is an effective means of implementing this image quality assessment, the long calculation time to determine LOC for whole images at multiple transmit powers is clinically unreasonable. Therefore, the automatic identification of small viable image regions is important prior to broad implementation of an automated ALARA tool. An algorithm for automated identification of viable regions to use for optimization was developed and tested on 90 B-mode images of fetuses and placentae. Clinical data used were collected following an IRB-approved protocol. The algorithm assesses brightness, motion, speckle statistics, and location to select a region. Identified regions were compared to results from our previous work that quantified which regions yielded reasonable LOC results. Preliminary results indicate that the algorithm reliably identifies a viable region on which to perform LOC calculations.

## **Oral Presentations**

### **Environmental Sciences**

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**Student Authors (s): Yan, Leonard; Chen, Judy; Bhilegaonkar, Sujay; Konin, Melanie; Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)**

**Mentors (s): Tyler, Lori; Appalachian State University**

**Analysis of Urbanization and Park Protection on Neuse River Basin Water Quality**

This research study was to observe the impact human development has had on water quality in the Neuse River basin, with data collections from Crabtree Creek, Marsh Creek and the Neuse River. This was achieved through the analysis of macroinvertebrate collections, water chemistry data, discharge, Bank Erosion Hazard Index (BEHI), and land use percentages taken from four different testing sites along each creek and river. Data revealed trends of water health remaining mostly constant (aside from one of the four sites which got worse) and the presence of strong negative relationships between the health of a site and the levels of phosphate and land use around it. Through these data and already published research on how phosphate levels and land use will damage a site, the original hypothesis that human development would have negative impacts on water quality was supported. In addition to exploring water quality, the impact climate change has had on discharge levels in the local area was observed as well. In contrast with the water quality analyses, discharge levels were unable to prove any strong trends and so further research would have to be undertaken to explore other effects of climate change. Overall, this study focused on determining possible factors that were causing changes in water quality and quantity for the Neuse River basin.

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**Student Authors (s):** Rapolu, Ruhie; North Carolina School of Science And Math

**Mentors (s):** Bruno, Michael; North Carolina School of Science And Math

**Impact of Inorganic UV filters on Aiptasia**

Coral bleaching is a destructive process that can permanently damage coral and can occur due to stress triggers from the environment. Sunscreen pollution, specifically the inorganic UV filters such as zinc oxide nanoparticles, in the open ocean can cause oxidative stress in coral and can trigger bleaching. This project examined the effects of metal oxide concentration and particle size on the bleaching of Aiptasia, a genus of sea anemone that is a model organism for coral due to its quick growth and reproduction and its bleaching response due to stress like coral. Zinc based sunscreen was dissolved in isopropanol and diluted into the tanks containing Aiptasia at concentrations of 200 µg/L and 50 µg/L. The death rate and the color change in the individual organisms were measured. Sunscreen containing zinc can bleach Aiptasia, and that bleaching is dependent on concentration: higher concentrations correlate with higher rates and stronger effects of bleaching as well as more destruction of the organisms. Preliminary results on zinc and titanium oxide particles suggest that particle size plays a role in coral bleaching. These results combined suggest that further research is required to determine how to best mitigate the effects of sunscreen pollution on coral bleaching.

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**Student Authors (s):** Nerurkar, Om; North Carolina School of Science And Math

**Mentors (s):** Murray, James;

**Estimating The Effects of Ocean Acidification on the Shellfish Industry: A Case Study in South Puget Sound**

South Puget Sound has a thriving shellfish industry that contributes tens of millions of dollars to the Washington State economy and thousands of commercial and recreational jobs. Unfortunately, ocean acidification has begun threatening the viable yield of critical shellfish species in this region. An increase in shellfish die-off events and larval mortality in the past two decades has been documented. There is a strong correlation between acidification and global and regional increases in dissolved CO<sub>2</sub> levels. The goal of this study is to predict how changing marine and atmospheric CO<sub>2</sub> levels will affect the yield rates of the two most economically valuable farmed shellfish species in the South Puget Sound bay. This study utilizes systems-dynamics modeling to relate included variables in three main phases. The first phase is an aquatic chemistry model that relates fluctuating CO<sub>2</sub> levels to a saturation rate. The second phase relates the changing calcium carbonate saturation rate to shellfish yield rates and consequent effects on the local South Puget Sound economy. One of the two species studied is harvested in hatcheries during the larval phase. The second generally reproduces in the wild. The conclusions derived from this study support future research on the effects of ocean acidification and other forms of climate change on aquaculture yield and regional economic development.

**Student Authors (s):** Charles, Thierry; Zhang, Grace; Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)

**Mentors (s):** Tyler, Lori; Appalachian State University

### **A Review of Significant Negative Emissions Technologies for Future CO<sub>2</sub> Emissions Reduction**

Though reducing carbon dioxide emissions is the most straightforward way to combat the effects of climate change, alternative energy sources, policies, and government promises have not been adequate. Negative emissions technology (NET), specifically carbon dioxide removal technology (CDR), compliments abatement well by directly targeting mass CO<sub>2</sub> emissions, but each NET will require different levels of research and development, costs/investments, and resources. In this paper, we discuss each major NET based on its carbon removal effectiveness, economic viability, and resource needs/limitations. These metrics will need to be weighed against one for future deployment of the following NETs: BECCS, CCS, DAC, and AR. Since resources such as food and water are part of the UN's Sustainable Development Goals, the impact of NETs on these resources must be minimized so that these global issues are not exacerbated. Our research compiles published scholarly journal articles and reports concerning NETs and juxtaposes them with the information provided by the IPCC regarding recommended practices and pathways for the future. In order to keep global average temperatures below 2°C, a goal set by the Paris Agreement in December of 2015 (assisted by the IPCC report), it is imperative that necessary steps are taken. We have come to the conclusion that the use of BECCS, despite potential limitations in cost-effectiveness and the use of land/water resources and ecosystem services, will create a more sustainable future when paired with other mitigation strategies.

**Student Authors (s):** Malone, Christian; Tidwell, Stephen; William Peace University

**Mentors (s):** Bonner, Lisa; William Peace University

### **Baseline biodiversity of the terrestrial biota in an undisturbed hardwood forest slated for road construction**

Shady Acres is a relatively undisturbed patch of old hardwood forest in Wake Forest, North Carolina. A small second order stream extends through the site from an area of moderate slope and levels out in a bottomland. The unnamed tributary runs into Smith Creek, which drains into the Neuse River. A road construction project is planned to transect the property in 2020-21, therefore we performed an initial census of the area in 2017, and then in 2019 began a detailed, long-term study to document the effects of construction on the terrestrial ecosystem. We concentrated our survey along the creek and on tracks of land extending 30 meters on either side of the stream throughout its reach to determine the biodiversity of amphibian and reptile populations. We performed two transects, established a series of zones, and closely quantified our collection efforts. Amphibian and reptile species diversity and abundance were fairly high. Unfortunately numerous anthropogenic factors have already negatively affected the ecosystem. Numerous running and mountain bike trails have been cleared throughout the property. The removal of ground cover, along with the almost daily human presence, has fragmented the site and reduced organismal movement, especially in the salamander and reptile species. These data should be a nice baseline to determine the effects of road construction on the biodiversity of the site, which we plan to monitor throughout the construction and for at least a year after completion to ascertain the long-term effects on these vertebrate populations.

**Student Authors (s):** Azad, Sahil; North Carolina School of Science And Math

**Mentors (s):** Bruno, Michael; North Carolina School of Science And Math

### **Identifying Natural Flocculating Proteins for Affordable Anti-Microbial Sand Filters**

An estimated 2.5 billion people lack access to improved sanitation and 780 million people to improved water sources worldwide. This is due to the high expense and difficulty of traditional microbial filtration methods. In these areas, slow sand filters are a possible alternate system, removing dissolved waste, protozoa and microbes. Previous studies have shown that functionalizing the sand with extracts of *Moringa oleifera* seeds can improve microbial filtration. However, the presence of *Moringa oleifera* is limited to southeast Asia. This project attempted to increase the virus removal capability of slow sand filters through functionalization with flocculating proteins found in naturally-occurring sources, from other parts of the developing world. Cacti, chia, basil and jujube were used as alternatives to *Moringa oleifera* chitin-binding protein. These seeds were crushed in water and the filtrate was used to functionalize silica glass beads, a sand analog. These beads were loaded into a filtration column and wastewater from a natural standing water source was allowed to filter through. The water samples were analyzed under a microscope, identifying and counting any detectable microbes. Compared to traditional sand filters, functionalized filters demonstrated increased microbial removal. The use of these natural microbe-removing seeds may allow for the use of affordable household sand filters yearlong in impoverished regions without the need for pretreatment.

## **Oral Presentations**

### **Humanities**

**Student Authors (s):** Hobgood, Malanah; UNC Greensboro

**Mentors (s):** Holian, Heather; UNC Greensboro

### **Rosso's Artistic Journey: Changing Locations and Changing Styles**

This research focuses on the stylistic changes in the artworks by early Mannerist artist Rosso Fiorentino. I argue that Rosso's stylistic changes were prompted by his personal relationships through family and other artists as well as his professional connections, rather than contemporary stylistic trends or solely requests from patrons. Rosso claims his place in history with his original style and innovative approach to ecclesiastical subject matter. Rosso travelled to several places throughout Italy starting in 1518 eventually making his way to the French court in 1530. This nomadic lifestyle was relatively unique compared to his contemporaries and allowed him to engage with various patrons and artists with distinct lifestyles which translated over into his commissions. I analyze the years from 1518 through his time in Rome where the changes in his style were most pronounced. I begin with an analysis of Rosso's familial background and its links to his training and his first commission for the Assumption of the Virgin at Santissima Annunziata. Next, I conduct a close examination of Rosso's time in Piombino at the court of the Appiani family in relation to his distinct style change in the Deposition from the Cross produced in Volterra. Then, heading back to Florence, I analyze Rosso's relationship with the Ginori family and artist Baccio Bandinelli regarding the commission of the Betrothal of the Virgin at San Lorenzo. To conclude my research, I focus on Rosso's time in Rome and the influence of artists around him on his commission, Dead Christ.

**Student Authors (s): Arredondo, Grace; Chowan University**

**Mentors (s): Hayes, Tim; Chowan University**

### **The Four Suitors**

This paper analyzes Jane Austen's romantic novel *Pride and Prejudice*. Although Austen writes during a period of social upheaval, her novel focuses on the typical lives of late eighteenth/ early nineteenth century Englishers. In a male-dominated society that held an attitude towards women that was belittling at best, young, single women were expected to marry suitable husbands and be known as admirable wives. Jane Austen's *Pride and Prejudice* challenges women's position in society by not only having a kaleidoscope of female figures drive the story's action and perspectives, but also showcasing an array of varying, multi dimensional male characters as essential, but secondary. Austen utilizes symbolism and important plot devices to depict each male suitor in a way that reflects the character, personalities, and motives of realistic individuals, while also using the faults of each to illuminate what she believes is the ideal man for a deserving, nineteenth century woman. The novel's four eligible bachelors, Fitzwilliam Darcy, Charles Bingley, Mr. Wickham, and Mr. Collins are all complex characters in search of an amiable wife. After establishing their character profiles and their place in the story, Austen comes to the conclusion that Darcy is the ideal suitor. Although his atrocious first impressions deceive the Bennets in determining his true character, his protective nature and genuine concern for those he cares about shine through his rough exterior in the end.

**Student Authors (s): Dutta, Srija; Elon University**

**Mentors (s): Tapler, Amanda; Elon University**

### **South Asian, College-Aged Women, and the Influence of Religion and Cultural Factors on Sexual Decision Making**

This study analyzed the role religion and cultural factors play in shaping sexual knowledge, attitudes, behaviors, and autonomy of college-aged, South Asian women. It's well documented that religious factors impact the development of sexual identity and decision-making among adolescents. Current research on South Asian students doesn't include the diasporas of South Asian women, and how their sexual identities have been shaped throughout their lives. This research provides an opportunity for South Asian women to explore factors associated with sexual development and autonomy. Sixteen South Asian women, enrolled in undergraduate institutions, participated in semi-structured interviews and focus groups. Potential participants were identified by peer and colleague connections, and the "snowball technique." Due to COVID-19, interviews and focus groups were conducted via Zoom. Religious beliefs and affiliation was explored in relation to sexual attitudes, behaviors, and sexual-decision making. Focus groups were used to gain a deeper, more comprehensive understanding of the themes and discrepancies unveiled by the interviews. Findings indicate parental influence, religious autonomy, and college culture play a significant role in sexual beliefs and decision-making of young South Asian women who participated in this study. 81% of participants reported growing up with parents who restricted their ability to have autonomy over their sexual lives. 85% indicated that college provided an opportunity to learn about human sexuality. Additionally, participants who had strong religious beliefs and who experienced religious stereotyping were more likely to articulate a lack of sexual autonomy. 73.3% of participants believed their college experiences positively influenced their sexual autonomy.

**Student Authors (s):** Jordan, Ginger; Chowan University

**Mentors (s):** Hayes, Tim; Chowan University

### **Behind the Frame: How the Frame Narrative Influences Readers of Frankenstein**

Mary Shelly's novel Frankenstein is known all over the world, and the frame narrative she uses to tell the story is a clever use of psychology. She influences the reader's opinion, manipulating them along the way, only to later challenge the thoughts she originally told the reader to believe. The use of a frame narrative is important to this method. The story encourages readers to challenge what they believe about people and how they see the world, and the frame narrative forces them to do exactly this. The reader is first introduced to a bias, then the bias is challenged by the next characters point of view, and in the end, the reader can easily see the parallels between the characters and how similar they are to one another.

**Student Authors (s):** Williamson, Alexis; Chowan University

**Mentors (s):** Hayes, Tim; Chowan University

### **The Untold Story of Wilmington**

In the late 1800s, Wilmington, North Carolina had many successful African American teachers, entrepreneurs, doctors and even elected officials. There were a few African Americans in the Republican Party, but some Democrats despised the fact of having African Americans in office during that time period. So a few White Supremacists devised a plan to have Wilmington's government overthrown by White Americans. This plan was put into action on November 10, 1898. The Wilmington Race Riot was not just an event of spontaneous violence. These events that took place on November 10, 1898, were part of a long-range campaign strategy by the Democratic Party leaders in order to regain the political control of Wilmington. On November 10, 1898, there was an eyewitness to the horrific events that happened in the African American Communities, and her name was Jane Cronly. In her account, she describes witnessing her African American neighbors being traumatized by white men carrying guns through the streets. She states that 'they have been as good a set of people as could be found anywhere.' Jane Cronly shows sympathy toward African Americans; she believes that they don't deserve any of this mistreatment. This event is an essential part of history in America because it shows the mistreatment and abuse of a group of people based on race and politics. Cronly's account is important because it draws public attention to the tragedy, to honor its victims and to shed light on this unforgettable event in history.

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**Student Authors (s):** Urban, Madison; UNC Chapel Hill

**Mentors (s):** Tasar, Eren; UNC Chapel Hill

**Bureaucratic Politics and Fractured Messages: Uzbekistan Religious Freedom Case Study**

This paper examines intragovernmental politics in the United States (U.S.) to better understand the development of religious freedom policy towards Uzbekistan post-9/11. The unique missions of the Department of Defense and the Department of State led to the proposal of vastly different, sometimes conflicting, policies. Despite deep political differences, the U.S. and Uzbekistan quickly developed a partnership after the 9/11 attacks shifted American attention to the Middle East. Military necessity and human rights prerogatives conflicted as U.S. officials struggled to credibly convey their human rights commitment to their autocratic military ally, Islam Karimov. To better understand the policy process, this paper analyzes government publications, cables from the U.S. embassy in Tashkent, articles from think tanks and the media, and memoirs of the people who oversaw U.S.-Uzbek relations. Synthesizing these accounts, this paper considers the lessons of the past and gives a framework for understanding how to cooperate with Uzbekistan in the years ahead.

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**Student Authors (s):** Spear, Lee Anne; UNC Chapel Hill

**Mentors (s):** Brundage, Fitz; UNC Chapel Hill

**Central Park as a Commemorative Landscape and Representation of New York City**

Central Park has become one of the most iconic locations in New York City. People around the country recognize the name, even those who have never visited the city. What many do not know, is that even early on Central Park has been used as a commemorative landscape. Monuments recognize a diverse group of people from throughout history. The park's history is as complex as the city it has come to represent, the monuments are a part of that history. While the park represents something different for each visitor, its use as a commemorative landscape is an integral part of its history and reflection on the city. Each monument represents something unique to the park, city, and nation. Central Park's monuments are a part of what makes it so reflective on the diversity of New York City, while also bringing to light some of the city's injustices. Despite those injustices the park has continued to change with New York City and its people. Ever evolving in purpose and reflection.

**Key Words:** commemorative landscape, diverse, evolving

**Student Authors (s): Knight, Abigail; UNC Greensboro**

**Mentors (s): Erin Lawrimore; UNC Greensboro**

### **War on the Homefront: Responses to the Influenza Pandemic of 1918 at Three North Carolina Colleges**

In 1918, an influenza pandemic began to spread across the globe. Across the United States, fears mounted as the death toll rose and it was up to many towns and colleges to figure out a way to protect their families and students. Unlike other diseases, the Spanish Flu struck the young and vigorous, making college students particularly susceptible. This research project explores the impact of the Spanish Flu on three North Carolina colleges: State Normal and Industrial College (now UNCG), North Carolina State College of Agriculture and Engineering (now NC State University), and the University of North Carolina (now UNC Chapel Hill). In particular, it explores the public health response to the pandemic at each university and how the outbreak affected campus and students who attended it. It aims to draw connections between each university in how the faculty, students, and families linked to these universities responded and the precedents that the campuses set for future epidemics during this pandemic when responding to the deadly outbreak of 1918. Also examined is the role that gender played in the response across the campuses and the language used in official university communications.

**Student Authors (s): Jacks, Jessica; Meredith College**

**Mentors (s): O'Keefe, Amy; Meredith College**

### **Culture, Context, and Communicating Christianity: The Missionary Career of Dorothy Mainhood**

In 1957, at the age of 26, Dorothy Mainhood sailed across the Atlantic to Southeast Asia where she was trained and sent out by Overseas Missionary Fellowship to Thailand. Mainhood faithfully dedicated the next fifty years of her life to serving the Thai people. Examining Mainhood's lifetime of service with Overseas Missionary Fellowship gives us a better understanding of the growth of the organization and the impact of a single Christian woman in Thailand between 1960 and 2010. This research examines Mainhood's goals as a missionary and how she achieved her main goal of discipling Thai Christians and helping young Christians grow spiritually. I set out to understand how she communicated her Christian values to the Thai people in a culturally relevant way (contextualization of Christianity). Several scholars of missiology discuss how understanding your own cultural values and the values of the country in which you work is one key to properly contextualizing Christianity. I concluded that some of Mainhood's personal values were aligned with Thai cultural values from the outset which, along with her excellent language skills, gave her an advantage in effectively communicating with the Thai people. Over time, as Mainhood embedded herself within the Thai culture, she developed a deep cultural understanding and internalized some cultural values of the Thai people which further increased her effectiveness in communicating Christianity.

**Student Authors (s):** Hudson,Tirrezz; North Carolina State University

**Mentors (s):** Jabir, Johari; University of Illinois at Chicago

### **A Praying Man, A Praying Spirit: Images of Prayer and Black Masculinity**

This work investigates constructions of Black masculinity and Black spirituality, specifically images of prayer in the 20th and 21st centuries. The construction of Black masculinity is not merely a replication of ideas based on white male biology, but the construction of Black manhood involves reimagining concepts of race, gender, class, and sexuality. The primary source for this project is Frederick Douglass' Narrative of the life of Frederick Douglass, an American slave. As an iconic figure in 19th century Black manhood, Douglass' autobiography provides a historic example of the construction of Black masculinity and spirituality, but the research and disciplinary frame of this study is an interdisciplinary cultural studies project. The constructionist approach to analyzing Douglass' autobiography is prominent in Black Masculinity Studies, and my investigation drawn from this field of study. In addition, I also enlist African American religious history, Black Liberation Theology, gender studies, and musicology. The intervention staged in this research is a close reading of Douglass' mention of prayer as a critical aspect in the tradition of Black male spirituality, a tradition seen, in the literal sense, in images of Black male civil rights figures such as Malcolm X and Dr. Martin Luther King Jr., and continues in contemporary examples such as Boys Om, Inc. Populist definitions of Black Masculinity often begin assuming Black Manhood is exclusively concerned with proving one's manhood, individually. But the tradition of Black male spirituality, specifically images of prayer, reveal a construction of Black male spirituality that is both individual and collective.

**Student Authors (s):** DeLayne Jolly; Elon University

**Mentors (s):** Moore, Ethan; Elon University

### **Remember When: The Role of Nostalgia in North Carolina's County History Museums**

Every day visitors at history museums find objects and stories which cause them to fondly remember the past, inciting a feeling of nostalgia. At small local history sites, where collections and historical narratives are often curated by community members with a personal connection to local history, the effects of collective memory are on display to be shared with locals and tourists alike. In the field of Southern public history, such nostalgic narratives have been critiqued for their tendency to downplay or erase social and racial injustice, as well as praised for their ability to connect working-class communities to the past. It is evident that collective memory, and specifically the emotion of nostalgia, makes a complicated but significant contribution to institutional conceptions of history. Using interviews I conducted with the administrators of eleven county history museums in North Carolina, I ask how nostalgia affects the goals, motivations, and practices of small community history museums. I conclude that private and shared nostalgia affect the ways in which museums present the collective memory of the past; through an emphasis on historic built environments, the collection of nostalgic artifacts, and the utilization of nostalgia as a tool to get audiences involved in history. Having established the ways nostalgia makes itself visible, I analyze the unique values, dangers, and challenges for the future that nostalgia presents in the context of small community history museums.

**Student Authors (s):** Cooke, Caleb; Duke University

**Mentors (s):** Goodacre, Mark; Duke University

### **The Failing of Bios: Luke's Gospel as a Continuation of the Scriptures of Israel**

Since Richard Burridge released *What Are the Gospels?* (1992), an expansion of Charles Talbert's *What is a Gospel?* (1978) which argues the gospels are not *sui generis* ("of its own kind; unique"), but instead best categorized as Graeco-Roman bioi, the discussion regarding gospel genre has slowed significantly. This paper aims to identify the shortcomings of Burridge's comparisons through a close examination of his methodology and criteria. In terms of genre, it is a more useful approach to consider the author's thoughts on his genre. Thus, I explain that the author of the Gospel of Luke did not liken his work to Graeco-Roman bioi; instead, through examination of Luke's active choices in the writing of his material, it is clear that Luke considered his writing to be a direct continuation of the Scriptures of Israel he regarded as authoritative. As a result, the ill-fitting categorization of the Gospel of Luke as a bios should be revised to Scripture, since that is what Luke considered his writing to be: Scripture that will be read alongside Scripture.

**Student Authors (s):** Brown, Heaven; UNC Charlotte

**Mentors (s):** Whitaker, Beth; UNC Charlotte

### **Politics as Usual: Restricting Immigrant Access to Public Assistance after the 1996 Welfare Reform Act Amid COVID-19**

The United States' federal public health response to COVID-19 has been widely ineffective. The administration's anti-immigrant agenda has left immigrant communities across the country without safety nets by excluding them from social service programs. Beginning February 21, 2020, the Department of Homeland Security's Inadmissibility on Public Charge Grounds Final Rule made the receipt of public assistance grounds for refusing immigrants legal permanent resident status. Observers are concerned that immigrants will disenroll or forgo needed public assistance during the pandemic for fear of jeopardizing their immigration status. These developments must be put into context, not as one-off pieces of legislation, but rather as the most recent example of anti-immigrant policy in a history of immigrant exclusion. The 1996 Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) served as a turning point in the history of undercutting immigrant access to federal means-tested entitlements, including food stamps, non-emergency Medicaid, and others. This paper provides a literature review on the 1996 Welfare Reform Act, including the (1) influence of anti-immigrant and anti-welfare framing; (2) exclusionary immigrant provisions; and, the (3) consequences, implications, and lessons that can be applied to the present. In reviewing these, I analyze data from the Department of Agriculture Food and Nutrition Service on SNAP participants' citizenship status. Bringing the literature review on the 1996 Welfare Reform Act to the present, this paper examines the Public Charge Rule. By simultaneously comparing and evaluating these policies, the past can inform policymakers on the ramifications of passing anti-immigrant legislation.

**Student Authors (s): Bosse, Leslie; High Point University**

**Mentors (s): Carlson, Matthew; High Point University**

### **Northrop Frye's Theory of Comedy and The Secret Garden**

Frances Hodgson Burnett's *The Secret Garden* relies heavily on Romantic conceptions of nature and the connection that children in particular have to the natural world. Mary and Colin, the two main characters, work to regrow a secret garden that has been locked up for ten years as both the garden and the children transition from a state of winter to spring. On a deeper, structural level, the story fits into Northrop Frye's theory of a comedy. Frye summarizes the overarching thematic characteristics of literary genres with a metaphor about the four seasons. In his theory, comedy is compared to spring because both comedic works and spring highlight a transition from reality to Romance- or from a state of experience to innocence. Frye also explains that comedies involve a metamorphosis through a "green world," which he defines as a tool used in comedic works that brings them the "victory of summer over winter." Another required aspect of Frye's definition of a comedy is a resolution centered around social reconciliation. While *The Secret Garden* may not fit every single characteristic that Frye proposes, it is, perhaps unintentionally, a prime example of this generic structure. This is shown through the text's literal and metaphorical transition into springtime, its connections to the green world concept, and its ending that focuses on a familial and societal reunion. This essay aims to analyze the relationship between Frye's comic theory and *The Secret Garden* through these main ideas.

**Student Authors (s): Ashworth, Rachel; William Peace University**

**Mentors (s): Otis, Katie; William Peace University**

### **Historic Sites in the South: The Good and the Bad of Enslaved Narratives**

What makes a historic site a historic site? Why do we designate buildings, districts, and/or statues as historically important? There are several factors that play into answering this question. When we look at historic sites in the South, we are examining so much more than white, wealthy landowners who were enslavers; we are also looking at the people they enslaved. Historic sites in the South present the narratives of enslaved individuals differently; though some have evolved to be more inclusive of enslaved narratives, some sites exclude or segregate them from the stories of white families. Language heavily affects the way enslaved narratives are presented, and something as simple as referring to a person as a "slave" rather than an "enslaved individual" sets the tone for the narrative. The myth of the kind master – the stories we hear of how a white enslaver was kind and never sold slaves away from their families, beat them, or otherwise mistreated them – also affects the way that we see enslaved narratives. In this presentation, I seek to examine various popular historic sites like Monticello alongside less well-known sites like Montpelier and North Carolina's own Haywood Hall and how the use of language, the presentation of the institution of slavery, and the myth of the kind master affect the way that we understand the enslaved populations of the United States.

# Oral Presentations

## Mathematics & Quantitative Studies

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**Student Authors (s):** Allen, Ciara; North Carolina Central University

**Mentors (s):** Weems, Kimberly; North Carolina Central University

### **Robustness of Maximum Likelihood Estimators in Poisson-Inverse Gaussian Regression Models**

The Poisson distribution is a well-known, discrete probability distribution that is commonly used to model count data. When using the Poisson distribution, one assumes equi-dispersion; that is, the mean and variance of the distribution of the data are equal. However, count data often exhibit over-dispersion, such that the variance is greater than the mean. To model over-dispersed count data, Poisson mixed models are often used where the mean is a random variable that follows a probability distribution, such as Inverse Gaussian, Gamma, or Lognormal, which is known as the mixing distribution. This project considers the Poisson-Inverse Gaussian (PIG) regression model, and the purpose is to test the robustness of maximum likelihood estimators (MLEs) of the PIG model parameters when the Inverse Gaussian (or mixing) distribution is misspecified. We simulate Poisson-Gamma (PG) and Poisson-Lognormal (PLN) data and compute MLEs for the regression parameters and the variance of the mixing distribution under an assumed PIG model. The simulation results show that the MLEs are robust to small perturbations of the mixing distribution, and in particular, the regression parameter estimates are less sensitive to mixing distribution misspecification than the variance component. We further illustrate the robustness of the MLEs of PIG model parameters with real data. Future work includes extending our results to multivariate Poisson mixed models.

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**Student Authors (s):** Hunter, Pascale; Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)

**Mentors (s):** Tyler, Lori; Appalachian State University

### **Trends in Human Randomness Generation**

It is commonly assumed that humans exhibit a bias while constructing and evaluating seemingly random sequences. However, while the gambler's fallacy has been observed in gambling scenarios, recent studies evaluating human randomness bias often conclude that there is little to no bias. Studies evaluating human randomness bias often focus on either gambling scenarios or binary sequences, in which there are only two possible outcomes. This study, by contrast, utilizes a standardized testing format in which subjects are presented with thirty consecutive questions with four variables to choose from. Thirty-six viable responses were collected from human subjects and analyzed. Survey responses are compared to randomly generated number sequences employing the Linux Random Number Generator (LRNG) and answer sequences from official College Board® standardized tests. After comparing the frequency of each possible response (As, Bs, Cs and Ds) along with the frequency of consecutive answer repeats (CARs), it is concluded that both standardized test answer sequences and human subjects have a strong bias against CARs, and human subjects have a bias towards Bs and Cs and a strong bias against Ds.

**Student Authors (s):** Singh, Arnav; Crowley, Jane; Indla, Justin; North Carolina School of Science And Math

**Mentors (s):** Koberstein, Nicholas; North Carolina School of Science And Math

### **Solution to MAA Problem 1177 using the Fundamental Theorem of Calculus**

The Fundamental Theorem of Calculus gives us a powerful theorem, establishing a relationship between differentiation and integration without using Riemann sums and without calculating areas. In this project, we explored how to utilize this fundamental calculus role in cooperation with others (i.e. Leibniz Differentiation, Lebesgue Differentiation, etc.) to examine the relationship with a continuous function that is equal to an elementary integral. Through utilizing the Fundamental Theorem of Calculus and all subsequent lemmas and corollaries, we set out to define a continuous function,  $f(x)$ , that would satisfy the integral equation,  $f(x) = \int_0^x \sin(t)f(x-t) dt$ , for all real values of  $x$ . Because this integral is a bi-variate function, we utilized Leibniz Differentiation to infinitely differentiate the given function and construct a corresponding McLaurin series for  $f(x)$ . Upon constructing the series and analyzing its higher order derivatives, we were able to conclude that  $f(x) = 1 + x^2/2$  is the only possible such continuously differentiable function that satisfies this equation.

**Student Authors (s):** Ramirez, Hilda; Forsyth Tech Community College

**Mentors (s):** Davis, Amanda; Forsyth Tech Community College

### **College Students' Approach to Order of Operations Math Problems**

A small-scale research study was conducted at Forsyth Technical Community College. The question posed for this research was: Can college students solve order of operations questions correctly without the use of a calculator? This research was conducted to explore the ways a student confronts an order of operations math problem with the help of the mnemonic device: PEMDAS. The data was derived from 51 students enrolled at Forsyth Tech. The students took a 4-question assessment that covered order of operation math problems arranged in level of difficulty. For instance, question 1 presented a simpler problem than question 4, which was a more complex problem. The students completed the study by answering a short survey stating how they felt while taking the assessment. The main results seen, comparing both male and female genders, was the difficulty dealing with operators and fractions. Some women stated that they experienced anxiety due to not having studied math in a long time. However, women in the study under-estimated their math abilities while scoring well on the 4-question assessment. Men on the other hand, had over-estimated their math abilities, but fell short on the assessment. My hypothesis was that men were going to out-perform women as it has been stated based on the research related papers. My hypothesis was nulled because the results were minimal and there was not sufficient data to declare which gender did overall better in math performance.

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**Student Authors (s):** Griesbach, Hanna; Elon University

**Mentors (s):** Awtrey, Chad; Elon University

**Isomorphic Polynomials: When is a Polynomial Isomorphic to an Even Polynomial?**

We quickly learn in single-variable calculus how important polynomials are. They allow us to analyze parts of functions, like their slope, while only needing basic arithmetic properties to construct. The most important points in the data are called roots, which are where the outputs equal zero. We can express the roots of a polynomial radically up to degree 4, but not necessarily for degree 5 and beyond. The benefit to solving a polynomial radically is that there is an exact answer and no error from loss of precision. The field of Galois Theory is motivated by the question of whether a polynomial can be solved radically or if its roots can only be approximated. For certain polynomials, like even polynomials, there are efficient ways to find whether the function is solvable by radicals. Our research explored when a polynomial can be transformed into an even polynomial for easier root computation. This transformed polynomial is characterized as isomorphic. To solve our problem, we looked at the differences between symmetries of even polynomials and non-even polynomials. Symmetries are responsible for moving the roots around the function. By looking at how the symmetries moved and grouped the roots, we found that even polynomials possess a symmetry that moves the roots to their reflections. Our research concluded that a non-even polynomial is isomorphic to an even polynomial if and only if it contains a symmetry that does not equal the reflection or the identity but when composed with itself two times yields the identity.

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**Student Authors (s):** Chance, Henry; Elon University

**Mentors (s):** Awtrey, Chad; Elon University

**Tamely Ramified Invariants for  $p$ -adic Polynomials of Degree  $2p$**

For a prime number  $p$ , the  $p$ -adic numbers are an important object of study in mathematics, computer science, and theoretical physics. Their unique symmetry properties also make them amenable to classification. In fact, it was shown in the 1960s by M. Krasner that there are only finitely many distinct polynomials of a given degree whose coefficients are  $p$ -adic numbers. Since that time, many researchers have worked to develop theory and computational methods to classify these distinct polynomials. So far, all polynomials have been classified when the degree is a prime  $p$  or less than 15. In this project, we consider the case in which the degree is equal to twice the prime number  $p$ . In particular, we classify the so-called tamely ramified invariants for polynomials of degree  $2p$ . This work is important for computing the symmetry properties of such polynomials, which have applications to quantum physics and dynamical systems.

**Student Authors (s):** Chan, Adrian; Ma, Sunwoo; Liu, Jeffrey; Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)

**Mentors (s):** Tyler, Lori; Appalachian State University

### **Effects of Intercountry Competition and Harvesting Strategy on Fish and Human Population Dynamics**

Previous studies have separately shown the predator-prey dynamics between two marine species, potential impacts of human activity on marine ecosystems, and the correlation of fish harvesting on population growth in humans. However, these studies have not fully explored or demonstrated the relationship between all three with comprehensive mathematical modeling. This study works to build and provide a modified model that gives a quantitative framework to show how fishing and human interactions can influence the dynamics of growth for various fish and human populations in an established marine ecosystem, including different countries. The variables of this model include the human consumption of fish on all trophic levels and the density-dependent factors of the fishing industry, as well as competition among countries. This study shows that human choices and the environment can interact in significant ways to shape the state of both fish and country populations. We discovered that to maintain a healthy and stable equilibrium of the human-fish species in an intercountry system, the amount of fish harvested at each trophic level must be proportional to the respective population size. Understanding how the food-chain dynamics are affected by human population growth and the tragedy of the commons is crucial to marine sustainability, conservation, and the stable equilibrium of the human population.

**Student Authors (s):** Lu, Shi-Ting; UNC Chapel Hill

**Mentors (s):** Hannig, Jan; UNC Chapel Hill

### **Gender Wage Gap of Assistant Professors in U.S public Universities**

More than 50 years since the Equal Pay Act of 1964, women are still paid less than men are. This study sheds light on the academic gender wage gap by comparing the salaries of assistant male and female professor within 3 years of being hired at U.S public universities. Our data comes from the salary reports from four public university systems in 2018 and 2019, which are available online under the Freedom of Information Act. Unlike previous studies, we use permutation test based non-parametric methods to avoid making too many assumptions. The results show that the most pronounced wage difference seems to be at around \$10,000 a month, i.e. the proportion of women making less than \$10,000 among all women is 12% higher than the proportion of men making less than \$10,000 among all men. The disparity is smaller among the high-earners and the low-earners. It is only among the middle-income faculty, which most faculty are, the gender wage gap occurs. In addition, most of the wage gap can be explained by the department effect; namely, some departments have high percentages of females while offering lower salaries. Nevertheless, at least in two out of the four universities analyzed, unexplained gender wage gaps still exist.

**Student Authors (s):** Alzate, Cesar; UNC Charlotte

**Mentors (s):** Li, Xingjie; UNC Charlotte

### **The Study of Covid-19 Within the State of North Carolina**

Research on COVID-19 was done on North Carolina to assess local governmental policies, measure COVID-19 growth rate, and discover what predictors impact COVID-19 spread. Using a Time-Delayed SIR model, removal rates were calculated to compare how seven major metros of NC handled the pandemic. COVID-19 Data was collected from Center for Systems Science and Engineering (CSSE) at Johns Hopkins, and the US census was used for NC demographic data. MATLAB was used to perform multiple linear regression and solve the SIR model to evaluate local governmental policy by measuring four removal rates of each studied metro throughout the government control policies. The most substantial correlating factor for COVID-19 transmission was a young age. The White and Black population were correlating factors with COVID-19 spread. The leading age correlating predictor for the death rate in the largest metros was the 85-100 age group. In this same analysis, the 51-84 age group was found to be inversely correlated. Through the removal rate calculation, we found that upon lockdown restrictions being eased, locations near the coast suffered, despite doing well in removing infected COVID-19 persons. In the populous Charlotte-Concord-Gastonia metro, COVID-19 growth rates were higher than other metros. Nevertheless, it had the highest removal rates meaning this metro did well in handling the pandemic. Lastly, our education study indicates less education correlates with COVID-19 cases.

## **Oral Presentations**

### **Medical & Health Sciences**

**Student Authors (s):** Roychoudhury, Hrishika; North Carolina School of Science And Math

**Mentors (s):** Cooper, Kat; North Carolina School of Science And Math

### **Noninvasive Treatment of Diabetes - An In-Vitro Analysis of Chitosan-Insulin Nanoparticles for Oral Insulin Delivery**

Diabetes mellitus, Type1 and Type2, are metabolic disease of digestive system affecting more than 100 million people around the world. Insulin, a hormone secreted by pancreatic  $\beta$ -cells plays a crucial role to regulate blood-glucose in diabetes. Insulin is commonly administered by subcutaneous injections, leading to low patient compliance. Oral insulin administration is most convenient route; however, oral insulin delivery remains a challenge because its limited absorption. The main barriers faced by insulin in the gastrointestinal tract are low bioavailability due to insulin degradation in the gastrointestinal tract by proteolytic enzymes, severe pH physiological conditions and poor permeability through intestinal epithelium. Nanotechnology can play a big role here. Chitosan is a natural biopolymer derived by partial deacetylation of Chitin which is generally found in crustacean. Being a good mucoadhesive polymer, chitosan can prolong the Insulin retention in the gastrointestinal tract. It also has excellent permeation enhancing effect and binding effect to epithelial cells. The current project developed a novel method of chitosan-insulin nanoparticle self-assembly and evaluates its effectivity in oral insulin delivery. The nanoparticles size and morphology were analyzed by dynamic-light-scattering (DLS). The average particle size obtained was ranged from 200 to 500 nm. The average insulin encapsulation was 80%. In-vitro insulin release profile showed that self-assembled nanoparticles were efficient in retaining insulin in simulated gastric condition, while significant insulin release was observed in simulated intestinal condition. Hence the project concludes that self-assembled chitosan-Insulin nanoparticles show promising effects as potential insulin carrier and can be used successfully in oral insulin delivery.

**Student Authors (s): Balu, Abhinav; Duke University**

**Mentors (s): Ariely, Sumedha; Duke University**

### **Understanding the Racial Disparities to Access to Physical Activity and the Resulting Health Outcomes**

In 2018, the Department of Health and Human Services recommended that children and adolescents engage in at least 60 minutes a day of physical activity (PA). This recommendation is based on evidence that PA has been shown to decrease all-cause mortality and enhance life skill development for youth. In spite of the plethora of benefits of PA, only 24% of youth meet the recommendation of 60 minutes of PA daily. This is especially problematic for minority youth, given that minority status is associated with even lower levels of PA. The majority of existing literature focuses on this disparity in PA as it impacts physical health outcomes at a single timepoint. Very little is known about the longitudinal effects of limited access to PA during childhood. I argue that the effects of limitations to PA are much broader and more severe (in both timeframe and magnitude) than what has been studied so far. Specifically, I argue that these limitations contribute to existing racial disparities in mental health and physical health as measured by weathering and allostatic load. This occurs through differences in life skill development as the causal mechanism. Life skills are defined as the social and psychological resources that one develops over a lifetime to buffer the effects of discrete and chronic life stressors. To that end, this analysis serves to provide a comprehensive overview of the barriers to PA that minorities face in order to inform potential interventions that can help reduce the observed racial disparity in health outcomes.

**Student Authors (s): Hussein, Natalie; Cooper, Shauna; UNC Chapel Hill**

**Mentors (s): Cooper, Shauna; UNC Chapel Hill**

### **First-Generation College Students' Academic Adjustment and Well-Being: The Role of Stress and Social Support**

Studies suggest that first-generation college (FGS) students when compared to their continuing-generation peers have lower grade point averages, less peer support, less family support, and work more hours. Previous research on FGS and social supports is largely qualitative. The current study addresses three specific questions: (1) What specific stressors affect first-generation students?; (2) What social supports do first-generation students have?; and (3) Does social support moderate the impact of stress? The data was used from a larger, university based sample that explores the experiences of 172 first-generation college students attending a large flagship southeastern university. Participants completed an online survey about their college experiences. Hierarchical regressions were conducted on three levels; domains of stress, domains of social support, and outcome variables. The results concluded that interpersonal and intrapersonal stress were both positively associated with depressive symptoms ( $p=.02$ ,  $p=.005$  respectively). Academic stress was negatively associated with GPA ( $p=.03$ ) and family stress was negatively associated with life satisfaction ( $p=.044$ ). Family support and friend support were positively associated with life satisfaction ( $p=.048$ ,  $p=.03$ ; respectively). Friend support was negatively associated with GPA ( $p=.037$ ). Social supports were not found to significantly moderate stress for FGS. Overall, this study supports existing studies. Future research should explore protective factors for first generation college students. Overall, this investigation has implications for program development targeting first-generation college students.

**Student Authors (s): Barnes, Autumn; Duke University**

**Mentors (s): Stewart, Kearsley; Duke University**

### **Perspectives on Genetics Research and Cures for Sickle Cell Disease in Uganda**

Sickle cell disease (SCD) is the most common genetic disorder of the blood. It can affect nearly every system of the body, resulting in morbidities such as kidney damage, stroke or pulmonary hypertension. Notably, there is a great deal of heterogeneity in its expression. Genomics and genetics research offer keys to understanding this variability and have the potential to provide new, integrated, targeted therapies for addressing this disease burden throughout the most heavily impacted regions of the world. However, in order to facilitate effective and responsible research and the implementation of these emerging technologies, it is essential to have an understanding of the needs, values and beliefs of these communities. Therefore, this study aims to investigate perspectives on participation in genetics research and curative therapies for sickle cell disease in Uganda. Using a qualitative phenomenological approach, we conducted 15 individual, in-depth interviews with parents of children living with sickle cell disease in Kallangala, Uganda. We analyzed transcripts with NVivo 12 using applied thematic analysis and identified emergent themes related to the use of traditional medicines in the management of sickle cell disease; participant understanding of genetics research in terms of issues of paternity; and perspectives on giving blood samples for research purposes. These findings may have significant implications for conducting genetics research and the implementation of resulting curative technologies within these rural populations. Further research will engage patients, and health care providers, NGO professionals and policy makers involved in sickle cell disease care or advocacy on these issues.

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**Student Authors (s):** Oduru, Srijan; Nagaraj, Kartik; Charvu, Anvi; Ravindran, Gautham;

**Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)**

**Mentors (s):** Tyler, Lori; Appalachian State University

### **Oxygen Consumption Normalized by Fat Free Mass in Normal and Overweight Adolescents**

Rising adolescent obesity rates in the US can be countered by assessing adolescent fitness status. Maximal volume of oxygen consumption ( $\text{VO}_{2\text{max}}$ ) is regarded as the gold standard of measuring fitness during exercise; however, it is pertinent to normalize  $\text{VO}_2$  values by body composition in order to assess work done by metabolic tissue. This study aimed to determine if normalizing by fat-free mass (FFM) would more accurately depict gas exchange parameters in overweight adolescents compared to normalizing by body mass (BM). 38 adolescent subjects were stratified into normal weight and overweight groups (19 NW, 19 OW) based on body fat percentage (BF%) criteria. Anthropometrics and body composition were assessed via stadiometer/scale and BodPod, respectively. Gas exchange values were obtained from a graded cardiopulmonary exercise test (CPET) on a cycle ergometer. Significant differences were observed between gas exchange parameters vs. BM ( $p < 0.05$ ) while nonsignificant differences were observed between gas exchange parameters vs. FFM ( $p > 0.05$ ) between normal and overweight groups. Data indicated strong positive correlations between FFM and gas exchange parameters and weaker positive correlations between BM and gas exchange parameters. Results supported both hypotheses. Normalizing gas exchange parameters by FFM is an effective method of determining CRF in overweight adolescents.

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**Student Authors (s):** Sobejana, Czarina; UNC Greensboro

**Mentors (s):** Boko, Tandeka; Forsyth Tech

### **Vaccination Rate in the campus of Forsyth Tech**

Scientists see vaccinations as a breakthrough for deadly diseases, but other people sees otherwise. Throughout history there have been controversies surrounding the idea of vaccinations. One example is removing thimerosal in 2002, a mercury preservative, in childhood vaccinations that some believed caused autism on children in the late 1990s and the recent monitoring of HPV vaccines that causes paralysis in females. But the FDA claims that all vaccines including HPV are safe to use and these are rare adverse effects. Is the public still wary of vaccinations to this day? This research is to look at a population, which in this case my institution's faculty members and students, and the ratio of the vaccinated and the unvaccinated within that sample. In the survey given to all people who volunteered, they were asked about vaccines they had and common misconceptions about vaccinations. The survey was answered by 186 students and faculty members of Forsyth Tech, and 88% of the population had said to be up to date on their vaccinations. All of the participants have reported to be vaccinated due to it being mandated for school, work, military duty, or travel. With the collected data from March to July 2020, there is already a high concentration of vaccinated individuals in the community. There were still some concerns about some vaccinations, but individuals had no problem receiving them. It will be interesting to see in the future, if there would be a vaccination for COVID-19, how many people would get the vaccine?

**Student Authors (s):** Shah, Ekta; North Carolina School of Science And Math

**Mentors (s):** Vavalle, John; UNC Chapel Hill

### **Outcomes of Transcatheter Aortic Valve Replacement with the Medtronic CoreValve Versus Edwards Sapien Valve**

Aortic stenosis, the narrowing of the heart's aortic valve, is the most common acquired heart valve disease and third most common cardiovascular disease in the developed world. The prevalence of this progressive heart disease is expected to further increase as our population ages. Transcatheter aortic valve replacement (TAVR) has emerged as an effective treatment for patients with severe, calcified aortic stenosis with two main valve types being used clinically - the Medtronic CoreValve and the Edwards Sapien Valve. By statistically analyzing patient data from past TAVR procedures, clinical complications and outcomes were compared between the Edwards Sapien Valve and the Medtronic CoreValve. Rates were calculated for all demographic and outcome variables by valve type; p-values were calculated using t-tests and chi-squared tests. The analysis included a total of 518 patients, with 359 receiving the Sapien valve and 157 receiving the CoreValve. Patients receiving those valves had similar rates of 30 day mortality (10.8% vs. 9.5%) and discharge status (98.6% vs. 96.8%), but had different rates of home discharge (88% vs. 81.5%), paravalvular leak (2.9% vs. 8.64%), and median ICU hours (0 vs. 48). Overall, the Edwards Sapien Valve had lower rates of complications and generally better outcomes than the Medtronic CoreValve, suggesting that the Edwards Valve may be the more effective valve to use in TAVR procedures. Further research analyzing patient data from a larger and different type of population is necessary to compare the two valves and confirm whether the Edwards or Medtronic CoreValve is more beneficial and effective in treating patients with aortic stenosis.

**Student Authors (s):** Narang, Isha; Ardrey Kell High School

**Mentors (s):** Narang, Ulind;

### **Identifying Tablets using Neural Networks**

According to the FDA, approximately 1.3 million people are injured due to medicine errors annually in the United States. A large percentage of these people are the elderly and people with multiple medical conditions. So, the purpose of my project was to utilize data analytics and machine learning methods to provide a simple way to identify tablets, thus reducing medicine errors. First, I took pictures of different tablets and applied various filters to them in WEKA. Then, I ran the Decision Trees algorithm on features generated by each filter and selected the Auto Color Correlogram filter because its features resulted in the highest classification accuracy of 88.75%. The accuracy of this filter with Neural Networks (NN) was 97.5%. With this evidence of NN being a good classifier, I ran the algorithm available at Teachable Machine on my dataset to generate an NN model using TensorFlow Lite. I imported this model and embedded it into an Android app, which I named 'Tablet Identifier'. I downloaded this app onto a virtual phone, and connected a webcam to my desktop in order to test the app. It correctly identified tablets with 99% accuracy. When published, more medications can be added for numerous medical conditions. Thus, anyone with a mobile phone can download the app, and identify any tablet when their phone's camera is pointed towards it. As a result, people will be able to use this user friendly app at home before taking their medication, which will lower the number of medicine errors.

**Student Authors (s):** Funk, Callum; UNC Chapel Hill

**Mentors (s):** Franz, Jason; UNC Chapel Hill

### **Automated Analysis of Medial Gastrocnemius Muscle-Tendon Junction Displacements During Isolated Contractions and Walking Using Deep Neural Networks**

Direct measurement of muscle-tendon junction (MTJ) position is important for understanding dynamic tendon behavior and muscle-tendon interaction in healthy and pathological populations. Traditionally, obtaining MTJ position during functional activities is accomplished by manually tracking the position of the MTJ in cine B-mode ultrasound images – a laborious and time-consuming process. Recent advances in deep learning have facilitated the availability of user-friendly open-source software packages for automated tracking. However, these software packages were originally intended for animal pose estimation and have not been widely tested on ultrasound images. Therefore, the purpose of this paper was to evaluate the efficacy of deep neural networks to accurately track medial gastrocnemius MTJ positions in cine B-mode ultrasound images across tasks spanning controlled loading during isolated contractions to physiological loading during treadmill walking. Cine B-mode ultrasound images of the medial gastrocnemius MTJ were collected from 15 subjects (6M/9F, 23 yr, 71.9 kg, 1.8 m) during treadmill walking at 1.25 m/s and during maximal voluntary isometric plantarflexor contractions (MVICs). Five deep neural networks were trained using 480 labeled images collected during walking and were then used to predict MTJ position in images from novel subjects 1) during walking (novel-subject), and 2) during MVICs (novel-condition). We found an average mean absolute error of  $1.26 \pm 1.30$  mm and  $2.61 \pm 3.31$  mm in the novel-subject and novel-condition evaluations, respectively. We believe this approach to MTJ position tracking is an accessible and time-saving solution, with broad applications for many fields, such as rehabilitation or clinical diagnostics.

**Student Authors (s):** Churiwal, Mehal; Alicardi, Annika; McCormick, Lauren; Nsehti, Naijha;

**UNC Chapel Hill**

**Mentors (s):** Lauria, Donald; **UNC Chapel Hill**

#### **Contributors of Diarrheal Disease in Bokaro, Jharkhand, India**

Diarrhea is a critical health problem in India due to inadequate water and sanitation, undernutrition, and a confluence of social and economic factors. Health professionals in the Bokaro district of Jharkhand, a state in northeastern India, reported high levels of diarrhea in their area to our research team. Those reports are supported by a 2016 study that found diarrheal diseases to be the most significant contributor to years of life lost from premature mortality in Jharkhand. Our team was awarded a research grant by UNC to characterize the burden of diarrhea in Bokaro and the local- and community-level factors contributing to it. Fieldwork consisted of eight focus groups plus interviews with 22 community members and 12 healthcare professionals. Study areas included urban commercial, urban slum, and rural communities in the Chas and Chandankiyari blocks of Bokaro. Perceptions of diarrhea prevalence were highly variable in our study population; health professionals expressed greater concern than community members. Those differences are partly explained by disparate understandings of what is meant by the term “diarrhea.” For example, community members often accepted multiple bowel movements per day as normal, whereas health professionals recognized them as being characteristic of diarrhea. We also found that community members reported potable water, functional sanitation systems, and personal hygiene resources being less accessible than government officials. These inconsistencies alongside ineffective communication between residents and professionals pose a serious challenge to accurately assessing the prevalence of diarrhea in the study areas, determining its possible sources, and developing effective mitigation strategies.

**Student Authors (s):** Stroud, Brandon; **East Carolina University**

**Mentors (s):** Sastre, Lauren; **East Carolina University**

#### **Development of a Validated Patient Satisfaction Tool to be Used in Dietitian-Centred Care.**

The field of Nutrition and Dietetics is highly lacking in comprehensive, validated tools to assess patient’s experience and satisfaction receiving nutrition care. The goal of this research project was to create and validate a patient satisfaction tool that could be used to evaluate nutrition care provided by Registered Dietitian Nutritionist (RDNs). An extensive literature review targeting primary, peer reviewed research focusing on patient satisfaction and perceptions regarding Registered Dietitian Nutritionist (RDN) care and/or nutrition care/services. The initial search identified 85 articles, and of these 11 were selected which met the search criteria. This literature review demonstrated limited existing validated questions and/or tools for examining patient satisfaction with dietetic/nutrition care. Based on the results of this literature review, previously validated questions were extracted from the final section of articles to develop a larger, more comprehensive survey tool. The final tool included questions focusing on “patient perception of their chronic disease (e.g. Diabetes, cholesterol), dietitian knowledge, cost of healthy food, comfortability with telehealth sessions, general patient knowledge gained from meeting with a dietitian, satisfaction with treatment processes, and patients satisfaction with how they currently handle their chronic disease state.” The final survey produced fills a critical gap within the literature. This tool can be used both in research as well as by practitioners in professional practice in the future, therefore, filling both a research and practice gap. Future studies should examine current RDNs perceptions and interest in using this tool in either research and/or practice.

**Student Authors (s):** Nguyen, Mai; UNC Charlotte

**Mentors (s):** Zhou, Qingning; UNC Charlotte

#### **Assessing risk factors for the incubation period of COVID-19**

COVID-19, a coronavirus disease that has resulted in a global pandemic and more than one million deaths worldwide, has extremely complex behaviors regarding transmission, symptoms and incubation period. A better understanding of these key characteristics is needed for scientists and policy makers to monitor and control the pandemic as well as to set up proper quarantine procedures. In this project, we investigate variables associated with the incubation period of COVID-19, defined as the duration between infection and symptom onset. The findings could provide some guidance on shortening or lengthening the standard quarantine duration of 14 days for certain subgroups to help better control the pandemic. In our preliminary study, we analyzed data from 463 Wuhan-exported cases who left Wuhan before the travel ban on January 23, 2020. The data set includes the dates of beginning stay in Wuhan, ending stay in Wuhan, and symptom onset, as well as age and gender. We considered three different methods of handling incubation period: midpoint imputation for infection time, treating incubation period as interval-censored, and multiple imputation for infection time based on a nonparametric estimate of its distribution. We evaluated the association of age and gender with the incubation period of COVID-19 under the Cox proportional hazards model which is commonly used for the analysis of time-to-event data. Our preliminary results suggest that younger people seem to have longer incubation period, while the incubation periods for male and female have no significant difference.

**Student Authors (s):** Chalmeti, Anushka; Lazarus, Caroline; Yalcinkaya, Berk; Kelley, Ferdinand;

**Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)**

**Mentors (s):** Tyler, Lori; Appalachian State University

#### **Design and Immunoinformatic Evaluation of a Novel SARS-Cov-2 Vaccine: Triple Recombinant Adenovirus Vector Expressing SARS-CoV-2 Virus-Like Particles**

SARS-CoV-2 is the highly contagious pathogen that is driving the COVID-19 pandemic. When the droplet-transmitted virus enters a host body, it travels down the nasopharyngeal and pulmonary tracts into the alveoli, triggering an inflammatory immune response that impairs the host's respiratory abilities. This study proposes a vaccine that is theoretically more immunogenic, accessible, and economical than the current options. The spike, membrane, and envelope antigens for this design were selected using data from multiple past studies and immunoinformatic tools. This vaccine is a triple recombinant Simian Adenovirus 68 expressing the SARS-CoV-2 spike, membrane, and envelope proteins. The vaccine induces virus-like-particle production in the host that closely mimics the infection from the SARS-CoV-2 virion. This vector-virus-like particle system combines the adenovirus's capability of inducing a robust innate and T-cell response with the virus-like particles' high immunogenicity and ability to induce a strong neutralizing antibody response. This system has the potential to induce a complete immune response by activating both humoral and cell-mediated responses. The vaccine is to be intranasally administered as a unidose dry powder, which allows the vector to mimic the route of a SARS-CoV-2 virion entering a human body while also boosting the immunogenic response through stimulation of both mucosal and systemic immunity. The vaccine's absence of a needle creates this more affordable and globally accessible option. Further study of this approach could lead to an efficient and effective clinical vaccine for SARS-CoV-2.

# Oral Presentations

## Physical Sciences & Astronomy

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**Student Authors (s):** Murphy, Austin; Appalachian State University

**Mentors (s):** Hester, Brooke; Appalachian State University

### **Cell Culture Methodology for Physical Property Investigation using Automated Optical Tweezer Apparatus**

The physical properties of biological systems can be investigated using an automated optical tweezer apparatus. Prior to investigation it is imperative to understand proper handling and care of biological substances. The correct procedure for cultivating and maintaining biological systems is referred to as cell culture. To conduct cell culture, cells are transferred from their natural environment to a favorable, artificial environment, designed for growth. In cell culture, physico-chemical factors, such as pH, temperature, O<sub>2</sub> and CO<sub>2</sub> tension, and physiological factors, such as hormone and nutrient concentrations, can be optimized for a specific biological system's needs. Optimizing conditions for the sample being analyzed is crucial to sustain viability of the sample and to acquire accurate data. Here, I present a detailed methodology and research applications, using automated optical tweezers, of cell culture.

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**Student Authors (s):** Mou, Megan; North Carolina School of Science And Math

**Mentors (s):** Bennett, Jonathan; North Carolina School of Science And Math

### **Modeling a Gold Nanoplasmonic Biosensor Using COMSOL Multiphysics**

Increasing interest in the development of new biosensors for use in the healthcare industry has led to demands for more sensitive, accurate, inexpensive, and easily manufacturable devices and methods to identify biomarkers that indicate disease or other biomolecular events. In this project, we used COMSOL Multiphysics to model the design and effects of a gold nanoplasmonic optical biosensor employing the use of surface plasmon resonance (SPR) and localized surface plasmon resonance (LSPR), as well as a change in refractive index, to detect different biochemical substances. When a biomarker attaches to the surface of such a structure, it shifts the local refractive index (a value closely related to absorbance and reflectance of light) and allows for detection. SPR is the resonant oscillation of electrons at a metal-dielectric interface induced by incident light and LSPR is generated by a light wave trapped within nanoparticles smaller than the wavelength of light, leading to localized oscillations with a resonant frequency that depends on many different factors and an intense localized electric field "hot spot". When these two phenomena are coupled with the use of a patterned thin film, a higher degree of sensitivity and accuracy can be achieved. The physical biosensor, which consists of periodic gold nanostructures embedded on a gold nanolayer, coats a substrate and lies beneath a layer of sensing medium. These nanostructures can consist of rods, cubes, and cones. An electromagnetic plane wave is incident on the structure and the resulting resonance is observed by plotting absorbance vs wavelength. The resulting sensitivity of the instrument as well as the SPR and LSPR effects are investigated.

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**Student Authors (s):** Sharma, Pranet; North Carolina School of Science And Math

**Mentors (s):** Treuthardt, Patrick

### **Comparison of Galaxy Spiral Arm Pitch Angle Measurements Using Manual and Automated Techniques**

Several important parameters in spiral galaxies can be determined by calculating the winding of their spiral arms, known as pitch angle, or PA. As a result, in order to gain a deeper understanding of several cornerstones of galaxy dynamics, accurate PA measurements are essential. In order to achieve superior efficiency, accuracy, and precision in measuring the PA of galaxies, a new program was introduced, improving upon the 2D Fourier transform algorithm P2DFFT. Rather than accepting the deconstructed galaxy center inputs to P2DFFT, the new method, P2DFFT:TRACED uses data points from traced galaxy arms. As a result, the program can eliminate any error-causing foreground stars or structural components (i.e. bulges and bars) and can enable a greater distinction to be established between the arms and interarm regions. Consequently, this method enables much of the noise in such images to be eliminated. When compared to several other automated PA algorithms, P2DFFT:TRACED consistently produced more accurate, precise, and detailed results, giving superior PA measurements for a more favorable automation-input balance.

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**Student Authors (s):** Kauffman, Elliott; Duke University

**Mentors (s):** Arce, Ayana; Duke University

### **Development of a Novel Jet Tagging Technique for LHC Collisions**

The ATLAS Experiment attempts to discover new phenomena by means of proton-proton collisions performed by the Large Hadron Collider. I will present a new search method for new phenomena in LHC events with a jet + photon using the metric known as Energy Movers Distance (EMD), which quantifies the difference between jets, which are cones of particles resulting from LHC collisions. I will use this metric to map jets based on their similarity, which could expose new physics. This stage of the study analyzes the distribution of this metric for events containing a jet and a photon, comparing events grouped by the combined jet + photon mass based on the jets' EMD values. The sensitivity of an EMD study is tested through two different methods. The first uses the average EMD value in a particular mass bin. The second uses a k-nearest neighbors strategy. These methods are tested by performing them on simulated ATLAS data then injecting anomalous jets into the data at different ratios to determine whether observing these signals is possible. I conclude that a more sensitive approach to analyzing the results of signal injection is warranted. This may include a more in-depth statistical analysis, using different injection samples, or trying to apply these strategies to ATLAS data directly.

**Student Authors (s):** Campbell, Joseph; North Carolina School of Science And Math

**Mentors (s):** Bennett, Jonathan; North Carolina School of Science And Math

### **Analyzing the Lateral Dispersion of Aerosols within Tropospheric Thermal Plumes**

Smokestack plumes were the number one source of greenhouse gas emissions in the world in 2017. Coal-fired power plants still account for approximately 30% of energy production in the world and roughly 40% of production in the United States. Although the United States has stopped authorizing new coal plants due to progress in renewable energy, some other countries are still planning on building more than 10000 plants by 2030. For this reason, the study of smokestack plumes and the particles they emit remains critical until the world moves away from coal. Furthermore, the gases and particulate matter released by plumes such as nitrogen dioxide, carbon monoxide, sulfur dioxide, lead, and more than one thousand others have been known to cause smog, acid rain, aggravation of respiratory illnesses, angina pectoris, and a variety of other environmental and health issues. The goal of this research is to determine how smokestack plumes are affected by the density of the aerosol particles within them. A higher density of particles can be due to a degradation of the scrubbing mechanisms and has been hypothesized to be incredibly dangerous to people in the areas around the power plant. The smokestack was simulated using COMSOL multiphysics software and had to solve equations in the turbulent flow, heat transfer, and particle tracing modules. These methods are applicable to many other areas such as wildfire tracking and the study of nuclear fallout.

**Student Authors (s):** Burgess, Kylie; North Carolina School of Science And Math

**Mentors (s):** Bennett, Jonathan; North Carolina School of Science And Math

### **Examining X-Ray Emissions from Repeating FRB 180916.J0158+65**

FRB180916.J0158+65 is a fast radio burst (FRB) with a set periodicity of  $16.35 \pm 0.15$  days. Its cycle consists of approximately 12 consecutive days, during which no radiation is observable, followed by 4 days during which bursts are able to be released. FRBs are distant, bright signals that have only been observed in the radio spectrum and whose origins are unknown. Due to its repetitive nature, FRB180916 presents the unique opportunity to observe an FRB in a section of the spectrum other than radio. Detection, or lack thereof, of the FRB in other sections of the electromagnetic spectrum will provide further context about its progenitor. In this study, previous X-ray observations from the location of FRB180916 were searched for X-ray radiation. We analyzed data from the archives of two telescopes: Chandra, which took pointed observations of FRB180916 during December of 2019, and ROSAT, which scanned FRB180916 during an all-sky survey from 1990 to 1991. We analyzed the Chandra data with Ciao software and the ROSAT data with HEASARC software. The data did not reveal any significant radiation between the energies of 0.07 keV and 7.29 keV from FRB180916.

# Oral Presentations

## Social & Behavioral Sciences

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**Student Authors (s):** Walker, Winter; Fayetteville State University

**Mentors (s):** Hilton, Doreen; Fayetteville State University

### **African American perceptions of their elementary through high school experience**

This study examined the perceptions of African American college students about their elementary through high school experiences to see if they had experiences that put them at risk for the school-to-prison-pipeline. African American children are more likely than any other race to follow the school-to-prison pipeline. a pilot study using a questionnaire. Thirty-six African American undergraduate college students participated in this pilot study by completing a 24-item questionnaire developed for the study that assessed their perceptions of their experiences in elementary through high school. The majority of the participants responded they had not been graded differently by teachers because of their, they had not been treated differently because of their race or socioeconomic status, they had not been discouraged from setting goals, and that they had not been labeled negatively. However, the majority of the participants responded that African American students received harsher punishment from teachers than did students of other races and that they felt disliked by their teachers. One-third of the participants reported they had had negative experiences with their teachers. It is important to look at the results of this study of school experiences in combination with experiences students have with their families and communities.

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**Student Authors (s):** Emily Yang; North Carolina School of Science And Math

**Mentors (s):** Amy Sheck; North Carolina School of Science And Math

### **Hermit crabs as a model system for resource distribution and acquisition in social groups**

Resource inequality is a pervasive and pressing issue affecting the well-being of individuals in societies around the world. Multidisciplinary researchers have previously utilized economic, sociological, and anthropological lenses to understand why and how inequality spreads in populations. However, recent studies have proposed that the distribution of shell resources in hermit crabs may be affected by factors analogous to those affecting the wealth distribution curves of human populations, indicating a potential for the use of hermit crabs in investigating resource inequality through a behavioral and biological lens. Building upon these studies, the effect of individual behavior, group size, and social interactions on the heterogeneity of resources in groups of terrestrial hermit crabs was examined. Crabs were placed in situations with varying levels of social interaction and their behavior observed and recorded. A distribution of initial shell resources was compared to that of shell resources following exposure to various levels of social interaction. Preliminary data indicates that crabs that change their shells tend to move into larger shells, and that shell switches tend to increase the Gini coefficient, a measure of resource inequality, of the sample group regardless of the allowed level of social interaction. Through this study, a foundation for understanding the effect of individual behavior, social interactions, and group size on the acquisition and distribution of resources, as well as an examination of the applications and limitations of utilizing hermit crabs as a model for studying resource distributions in human populations, will be formed.

**Student Authors (s):** Adetunji, Morire; Braha, Razvan; North Carolina School of Science And Math

**Mentors (s):** Thomas, Stephanie

### **What Social Media Use Can Reveal About Personality**

Previous research has found a correlation between personality and social media use. However, many studies conducted on this topic focused solely on a specific demographic, such as only one social media site, and certain age ranges. The purpose of this study was to analyze the relationship between personality and social media. A survey was conducted to obtain data for data analysis. JASP was used to perform the data analysis including correlational tests as well as ANOVA tests. Conscientiousness, neuroticism, and extraversion were found to have significant correlations with social media use. These three traits are correlated with things such as how often people post, comment on other's posts, the amount of time spent on social media, the ease of communicating with others through social media, and what kind of social media is preferred. Many demographic factors were taken into consideration when analyzing the data for this study. This study expands on previous research by examining the many ways social media use differs among different personality types.

**Student Authors (s):** Moore, Jayla; Campbell University

**Mentors (s):** Rushing, Nicole; Campbell University

### **Coping Styles of First-Generation University Students in their First Semester**

First-year students use a variety of methods to cope with their transition to college. According to Dyson and Renk (2006), the types of coping strategies used by students prove to be important to their adjustment to attending a university. Compared to continuing generation students, first-generation college students may experience additional stressors related to family support, finances, and overall adjustment to college, especially during the COVID-19 pandemic, but little is known about how first-generation students cope with such stressors. This study compared coping strategies on Carver's (1997) Brief COPE of first-generation and continuing-generation students across two cohorts (2019 and 2020; N=222) during weeks 5-6 of their first semester at a small, private university in the southeast US. While first-generation students reported generally using coping strategies more frequently than continuing-generation students, they were also significantly more likely to use avoidant styles of coping including self-distraction, denial, behavioral disengagement, venting, planning, and self-blame, especially in 2019. In 2020, first-year students were more likely than continuing-generation students to use acceptance. Changes in coping styles among first-generation students from 2019-2020 could be a result of having prior academic experiences during the COVID-19 pandemic. Understanding the various coping styles of students can help inform campus wellness initiatives focused on improving adjustment during the first year.

**Student Authors (s):** Last, James; High Point University

**Mentors (s):** Ringel, Paul; High Point University

**The disillusionment of Harlem during the 1950's - An analysis of *Manchild in the Promised Land* by Claude Brown**

*Manchild in the Promised Land* is an autobiography that recounts Claude Brown's coming-of-age story amidst poverty and violence in Harlem during the 1940s and 1950s, famed in the African American literary canon not only for its strikingly vivid narration, but for being one of the first works to accurately portray the struggles of Blacks against a hostile environment. One journalist described the book as "a guided tour to hell conducted by a man who broke out" (Boyd). From the first chapter of this book, the reader becomes aware that this so called "promised land" is more of a fictitious concept than a real place; a place where children are forced to act like men in order to survive. Brown is rife with violence, crime, and despair from a young age, and falls guilty to finding peace through misguided means. This paper will dive into the disillusionment of contrasting Harlem to the Promised Land. Brown articulates this disillusionment by revealing how Harlem was a grim reality in contrast to the notion that it was a place teeming with opportunity for African Americans. Furthermore, this paper will argue the impact and significance of generational differences between Brown, who was born in Harlem, and his parents who were raised as sharecroppers in South Carolina and later moved to Harlem in 1935.

Boyd, Herb. "Claude Brown. (tribute)." *Black Issues Book Review*, May-June 2002, vol. 4, no. 3, p.80. Gale Academic OneFile Select. Accessed October 12, 2020

[https://link.gale.com/apps/doc/A86041484/EAIM?u=hpu\\_main&sid=EAIM&xid=5dd741b5](https://link.gale.com/apps/doc/A86041484/EAIM?u=hpu_main&sid=EAIM&xid=5dd741b5).

**Student Authors (s):** Escate Saavedra, Andrea; Wingate University

**Mentors (s):** Candace Lapan; Wingate University

**Social and Emotional Learning- A Virtual Response**

Social and Emotional Learning (SEL) refers to the acquisition of knowledge, skills, and attitudes that allow individuals to create healthy identities, manage emotions, achieve goals, express empathy, build healthy relationships, and make good decisions. Increasingly, schools across America are adopting SEL programs in school to help students build these much-needed skills. Previous research shows that adolescents who participated in school based SEL programs lead to positive outcomes (e.g., improved grades, social skills, & relationship; Yeager, 2017). While most SEL programs take place face-to-face in schools, the goal of the current project was to develop a 5-week virtual SEL program for adolescents in response to the COVID-19 pandemic. The program introduced teens to SEL through group discussions and online peer interactions. Participants were adolescents enrolled in the Upward Bound Math and Science (UBMS) program, an academic and social enrichment program for low income and first-generation students. Lesson plans, presentation slides, reflection assignments were developed to address the five key SEL skills (CASEL, 2020). Through the use of focus groups, we gathered qualitative reports from adolescents on their perceptions of the program (e.g., interest, usefulness, perceived benefits). We noted a variety of implementation concerns relevant to the current population including limited access to quality internet, limited access to private space, and generally low attendance. However, students that did attend reported great satisfaction with the curriculum and believed that it taught them valuable skills. We discuss the benefits and challenges of delivering SEL programs virtually, particularly with low income students.

**Student Authors (s): Strack, Claire; UNC Chapel Hill**

**Mentors (s): Delamater, Paul; UNC Chapel Hill**

### **Geography of Vaccination Uptake and the Impacts of Policy Change in Pennsylvania**

Childhood vaccination in the United States continues to be a pressing issue, as vaccine hesitancy and low levels of vaccine uptake have led to a number of outbreaks. Prior to the 2017 school year, Pennsylvania's vaccination policy was updated with the intention of reducing the provisional entrance rates and in turn improving vaccination rates among kindergarteners. The new policy reduced the grace period, the timeframe in which provisional entrants must complete the multiple-dose vaccine series they are not up to date on, from 8 months to 5 days. This project explores the policy's impact on the geographic distribution of county-level provisional entry rates throughout the state as well as its impact on community-level factors' relationship with provisional entry rate. Clusters of counties with high or low provisional entry rates were not detected prior to the new policy, however they were detected after the policy was enacted, indicating that the policy had a variable impact across counties. Linear regression models at the county and school district levels both indicated that percent Black was a significant predictor of provisional entry rate. The models fit the data better following the policy, indicating that the predictor variables (race, income, education, insurance, and rural composition) better captured provisional entry rate following the implementation of the new policy. These findings provide a foundation for further research on this policy's impact, specifically on why it may have had a variable impact across the state.

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**Student Authors (s):** Campbell, Cameron; Johnson C. Smith University

**Mentors (s):** Luciano, David; Johnson C. Smith University

**The Pursuit of Happiness: Effects of Depression Among African American Male Undergraduates**

It has been proven that depression is a factor that impedes academic success and contributes to negative factors both physiologically and psychologically. This research will focus on African American Male College Students and the effects of depressive behavior using the Center for Epidemiologic Studies as a survey to determine how depressed they are.

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**Student Authors (s):** Goel, Shreya; Kandyala, Pramati; Mohammed, Hannah; Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)

**Mentors (s):** Tyler, Lori; Appalachian State University

**Determining the Feasibility of Voice Recognition as Forensic Evidence: A Review of the Literature**

Voice recognition makes use of human listeners and automated systems to identify speakers in an audio or to match unknown voices to known voices. Currently, voice recognition technology has various applications in different fields requiring unique identification techniques. This research explores the possibility of a forensic application of voice recognition technology. The experiment was broken down into two parts: 1) search iterations that generated numerous articles varying in relevancy to voice recognition, from which a data sample of 18 articles was established and 2) examining publications in this 18-article sample to determine accuracy of voice recognition technology, possible forensic utility, and other applications. Overall, voice recognition technology was found to be falsely accurate. Correct identification occurred when automated systems were exposed to distractor elements before being exposed to tested audios, skewing the accuracy of the technology. In remaining instances, automated systems, human listeners, and earwitnesses were largely unable to identify speakers or match voices due to factors such as voice disguise, poor audio quality, background noise, poor emotional state of the speaker, and changing voice characteristics, among others. This lack of accuracy leads to the conclusion that voice recognition still requires significant research and testing before it becomes applicable to the field of forensics and can be submitted as evidence in court.

**Student Authors (s):** Slack, Olivia; Meredith College

**Mentors (s):** Manzo, Whitney; Meredith College

### **A Generational Analysis of Attitudes Toward Women in Politics**

Using a combination of focus groups and an online survey, this study examines Generation Z's political attitudes, specifically toward women in politics. The researchers primarily explore how generation, gender, and political party affect respondents' views of women. A qualitative analysis of 37 members of Gen Z was conducted in order to understand how the independent variables influence views of women in politics. The hypothesis stated that Gen Z men have more traditional, conservative views toward gender roles, while Gen Z women have more progressive views. The hypothesis was not entirely supported. The researchers found that both men and women in Gen Z have positive views toward women in politics, even if they could not pinpoint a specific woman they would vote for currently. Themes from the respondents' focus group discussions include the idea that neither gender has innate characteristics that would make them more or less qualified to be politicians and that if there were more women in politics, this would empower young girls to believe they are capable. The benefits of diversity in the political sphere were also highlighted. Based on these findings, the potential impacts of Gen Z on women's prominence in politics in the coming decades should not be underestimated.

**Student Authors (s):** Parker, Halle; Johnson C. Smith University

**Mentors (s):** Rawle, A. London; Johnson C. Smith University

### **The Levels of Depression Among College Students Who Attend Historically Black Colleges and Universities**

While we all feel sad, moody or low from time to time, some people experience these feelings intensely for long periods of time (weeks, months or even years) and sometimes without any apparent reason. Depression is more than just a low mood, it's a serious condition that affects your physical and mental health. The purpose of the study will be to examine the variables which may cause depression among college students who attend HBCUs. Researchers have found college students who attend historically black college and universities are strongly affected by their mental health during their school years. They have also found if there are any variations in perceived symptoms of depression during the school year that may have caused a significant impact on their daily lives. The purpose of this study is to add important information of research to examine their state of mind, self-worth, and the cause of depression among individuals.

**Student Authors (s):** Haverstic, Clara; Cefalu, Ally; Meredith College

**Mentors (s):** Edwards, Cynthia; Meredith College

### **Racial and Socioeconomic Diversity in Gifted Intelligence Testing**

Gifted Education programs tend to be unproportionately populated by white upper class students, leaving a large portion of minority students underserved. This literature review examines the existence of the racial socio-economic gap in gifted programs and intelligence testing, and methods that could reduce the gap. Data from the National Center for Education Statistics found that 7.7% of white students are enrolled in gifted programs, as opposed to only 4.3% and 4.9% of black and Hispanic students. Most programs base acceptance on IQ scores, which have been shown to exhibit bias to racial minorities and those in lower income brackets. If schools are to continue using IQ scores for acceptance, there are possible changes that could be made to increase the racial and socioeconomic representation in gifted programs. The implementation of universal screening is a first step that would improve representation by negating the need of subjective recommendations from classroom teachers. There are, additionally, alternate intelligence tests that have been designed to reduce the influence that prior schooling has, and yield higher rates of minority students meeting the definition of “gifted”. Testing context could also be changed to reduce the effect of stereotype threat on testing scores. The implementation of any or all of these changes could reduce the inequalities present in the current system. Further studies could examine specific combinations of these methods (pre-screening, testing, and context) to find the most efficient solution for schools.

**Student Authors (s):** Feiler, Tatum; East Carolina University

**Mentors (s):** Dolbier, Christyn; East Carolina University

### **Posttraumatic Stress Disorder Specific to the Coronavirus Pandemic: Risk and Protective Factors Among College Students**

There is minimal research examining the effects of pandemics on college student mental health, so it remains unclear if there are risk and protective factors unique to this group that influence the development of post-traumatic stress disorder (PTSD). The objectives of this study are to: 1) determine the rate of positive screens for PTSD specific to the coronavirus pandemic in an undergraduate student sample; 2) determine which risk factors identified in previous research (e.g., higher actual or perceived risk of exposure, compliance with measures to prevent infections) are associated with an increased rate of PTSD; and 3) determine which protective factors identified in previous research (e.g., social support, access to counseling services) are associated with a decreased rate of PTSD. After obtaining IRB approval, undergraduate students at a large southeastern public university (N=2000) will be randomly selected to participate in this online survey study during the 2020 fall semester. Our target sample size is 400 undergraduate students. Participants will be entered into a gift card raffle upon completion of the survey. PTSD will be assessed with the PTSD Checklist for the DSM-5. Risk and protective factors will be assessed using the Stressful Life Events Screening Questionnaire, Brief Coping Orientations to Problems Experienced Scale, Patient Health Questionnaire 8, Generalized Anxiety Disorder 7 Scale, MOS Social Support Survey, UCLA Loneliness Scale, Lubben Social Network Scale, Brief Assessment of Family Functioning Scale, and items our team developed and sampled from other epidemic studies. We will analyze the data during the 2021 spring semester.

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**Student Authors (s): Ellis, Jaida; Elizabeth City State University**

**Mentors (s): Kaur-Walker, Kulwinder; Elizabeth City State University**

### **A Quantitative Study of the Effects of COVID-19 on Student Social Engagement**

How higher-level students engage in and outside of the classroom has recently become a topic of interest in the scientific community. This study aimed to investigate how the coronavirus (COVID-19) pandemic has impacted the student engagement due to current social distancing measures altering the student experiences. Fifty-six adult college students with varying backgrounds responded to questions about their demographics, academic performance, classroom, research and social engagement before and during the pandemic using an anonymous Qualtrics survey link for the study questionnaire shared via social media. Data were analyzed using IBM SPSS Version 26. Descriptive statistics recorded as average of responses on a five point Likert scale with 1 being at the lowest and 5 being at the highest end for class engagement, cell phone usage and research engagement were 3.88 (SD = 0.529), 3.24 (SD = 0.683), and 3.71 (SD = 0.515) whereas the paired sample t-test used as inferential statistic for comparison of students' engagement habits before and during the pandemic, for the given data did not show significant differences for social engagement before and during COVID-19 pandemic but the means for both the categories appear different. Correlation analyses of study variables indicated that higher letter grade was associated with higher class and research engagement; social engagement significantly associated with research engagement before COVID-19. At the time of this abstract submission, the data collection was still in progress, thus, the findings at the time of presentation may be different. Keywords: student engagement, social, research and classroom engagement, coronavirus, COVID-19

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**Student Authors (s): Curia, Jenna; Meredith College**

**Mentors (s): Edwards, Cynthia; Meredith College**

### **A Qualitative Analysis of Attachment and Resilience Among the Adult Children of Opioid and Multi-Substance Dependent Mothers**

Research suggests that a bond with a reliable, emotionally stable individual, typically a parent, formed during infancy and sustained throughout adulthood is important in predicting resilience in times of change and adversity. Attachments formed during infancy are a key indication of how the adult child will respond to challenges. Maternal opioid dependency can cause decreased oxytocin levels, a hormone that is essential to early emotional bonding. Reduced oxytocin levels among new mothers can lead to the absence of empathy, closeness, and a sense of connection to their infants. The present study examined disrupted attachment patterns among (N = 26) adults, ages 19-35, whose mothers struggled with opioid addiction and co-morbid substance abuse; exhibiting addictive behaviors and mental health challenges present during the prenatal period and sustained throughout their children's lives. Participants were given a series of qualitative writing prompts regarding their sense of connection to their biological mothers and how this relationship impacted their perceptions of transitions into adulthood. Findings include a decreased sense of maternal connection, greater responsibility and independence, higher levels of anxiety, and increased performance. Participants also reported feelings of self-blame, fear of abandonment, and often a relationship with one or more influential adults outside of the home during childhood and adolescence. One participant said, "I believe the ones who love us like a mother - unconditionally, persistently, freely - those are the relationships that matter the most. And sadly, but also wonderfully, those relationships don't always take place between a mother and her biological child." Qualitative analyses are ongoing.

**Student Authors (s):** Cefalu, Ally; Meredith College

**Mentors (s):** Edwards, Cynthia; Meredith College

### **Depression and Anxiety as Potential Mediators of Academic Motivation, Procrastination, and Achievement**

In a time full of easy access distractions, motivation and procrastination have become important aspects of university life. Previous literature explains that an individual's academic motivation occurs on a continuum of internal and external styles, while procrastination varies situationally. When these behaviors are combined with the appearance of anxious or depressed symptoms, academic achievement can suffer. Anxious students tend to have higher motivation levels and lower procrastination levels than their non-anxious or depressed peers and are often motivated by a fear of failure. Conversely, depressed students tend to have lower motivation levels and higher procrastination levels. The present study aimed to examine all of these variables in the context of academic achievement, measured by Grade Point Average (GPA). The overarching hypothesis was that motivation and procrastination would act as mediators for depressed and anxious symptom frequency. The researcher predicted that depressed students with external motivation styles and higher levels of procrastination would have lower GPAs. It was also hypothesized that anxious students with internal motivation styles and lower levels of procrastination would have higher GPAs. Undergraduate students across multiple universities in the Triangle area (N = 45) completed an online survey containing the University Student Depression Inventory, the anxiety subscale of the DASS-21, the Academic Motivation Scale, the Academic Procrastination Scale, and a brief demographic questionnaire developed by the researcher. Data collection was completed during the month of September 2020 and preliminary analyses are forthcoming.

**Student Authors (s):** Black, Kelsey; East Carolina University

**Mentors (s):** Christensen, Tim; East Carolina University

### **Face to Face: It's Personal**

Sexual assault is a major problem at colleges and universities all across America. Our project "Face to Face: It's Personal" aims to educate students at East Carolina University on what they can do to prevent sexual assault and how they can help victims of it. The first program we implemented to help prevent sexual assault is modeled after Hooters' "Angel Shot" program. There are posters in the women's restrooms that instruct the woman to go to the bar and order a shot that contains a code word that signals to the bartender that she needs help. Our code is specific to the Uptown Greenville area. As of right now, we have this program at Fifth Street Distillery and Annex, and we are working to get in more bars and restaurants uptown. We are also setting up self-defense classes on campus that are taught by the ECU Police Department. They are separated by gender, as both males and females need to learn defense methods since either gender can be a victim. We are working with the Student Safety Committee, which we are members of, to set this up. The last part of our project is to honor the victims of sexual assault. We are working with our mentee Honors 3000 group to create an art exhibit that displays art in their honor. We hope this project will have a lasting impact at East Carolina.

**Student Authors (s): Ayala, Sarahi; Fayetteville State University**

**Mentors (s): Fu, Chu-Chun; Fayetteville State University**

**Language Brokering as it Relates to Depression and Anxiety within the Latinx Community**

As immigration continues to grow in the United States, more foreign-born individuals are depending on their children to become their cultural and linguistic mediators. Previous studies have shown that language brokering has various positive and negative effects on a broker's mental health, specifically relating to depression and anxiety. The purpose of this study is to examine how a language brokers parent-child bonding and gender affect their risk of experiencing depression and anxiety. Through the consent of Drs. Morales and Wang, their data was used in the process of this study. Their sample included 678 Latinx college students attending two Southern California colleges. They conducted a cluster analysis using the four subscales of the Language Brokering Scale: People, Places, Things, and Feelings; and compared their results the Center of Epidemiological Studies Depression Scale, the State and Trait Anxiety Inventory for Adults, and Parent-Child Bonding Scale. In this study a descriptive analysis was used to find the means of all the main variables and an intercorrelation analysis was conducted to find which variables correlated with one another. The results revealed that language brokering was related to depression and parent-child bonding but not to anxiety or gender.

# Poster Presentations

## Arts, Design, and Performing Arts

**301**

**Student Authors (s): Ricciardelli, Justine; Appalachian State University**

**Mentors (s): Helms, Chelsea; Appalachian State University**

### **How Might We Design a Inclusive Facility for All Ages and Disabilities to Foster Physical Health and Social Skills?**

Too often, people of all ages with disabilities are not given the same opportunities as those of a neurotypical status. Children and adults with special needs, physical and learning disabilities need a space to develop physical health and social skills. This facility will allow the user group to be active while also receiving tutoring and career readiness skills. The intended users will be children and adults who struggle with these disabilities. Design problems that can be expected are creating ADA standard designs, considering different disabilities and different learning styles that may need different attention for the design to be successful. Research into location setting for this facility is important to its efficiency, as well. Methods developed will be focused on what is necessary in the space for circulation, materiality, COVID guidelines and space planning. In conclusion, the space will be developed through evidence based research and first person experiences.

**302**

**Student Authors (s): Kanoy, Kelsi; Appalachian State University**

**Mentors (s): Helms, Chelsea; Appalachian State University**

### **COVID-19 Preventative Airport Terminal**

Because of COVID-19, the world is no longer a familiar place. Everything is different, from the way we work to the way we interact with one another. Things that used to require no thought are now obstacles to overcome, traveling being one of them. Airports are particularly dangerous because of the daily influx of people from all over the world moving in and out. Contact tracing becomes virtually impossible. Being that the virus is still so new, the world is learning how to adjust and determining which changes will be long-lasting and which will not be. COVID-19 has brought to light the idea of considering others' health and safety above your own. For this reason, it is a reasonable assumption that many of the health precautions brought on by this pandemic will remain even after COVID-19 is less of a concern. It is important to consider how high-traffic spaces like airports can be reconfigured so that the transition is as seamless as possible. The goals for the COVID-19 preventative airport terminal are that it brings a sense of familiarity to its users, is a place of excitement rather than anxiety, is safe, and universally functional.

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**Student Authors (s): Gibson, Elizabeth; Appalachian State University**

**Mentors (s): Helms, Chelsea; Appalachian State University**

### **Residential Eating Disorder Treatment Center**

An eating disorder treatment center for adults over the age of 18 that provides housing, various levels of treatment, mental and physical [individual and group] therapy, meal support, and overall well-being healing in Columbia, South Carolina. Among U.S. adults 18 and older who sought out treatment for both an eating disorder and an additional illness included 33.8% of respondents with anorexia nervosa, 43.2% with bulimia nervosa, and 43.6% with binge eating disorder. There is plenty of evidence to demonstrate that these diseases are not exclusive to those under the age of 18. Rather than growing out of eating disorders, many people with this disease continue to live with this condition from adolescence all the way into late adulthood. It is important for adolescents to seek treatment. It is just as important for adults to seek or continue treatment. Many comments from physicians tell patients that they should have “grown out of” eating disorders or that they are “too old” for them. Those sorts of comments lead people to go back into the shadows and not reach out for the treatment they deserve. Therefore, creating a residential eating disorder treatment center for adults 18 and above will be meaningful as it can provide an emotional connection and understanding amongst each other (residents) and share in the treatment of getting better for themselves and not to feel as though they are a burden to their loved ones.

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**Student Authors (s): Coston, Michael; UNC Charlotte**

**Mentors (s): Grymes, Jay; UNC Charlotte**

### **Yiddish Songs from the Holocaust: A Resource for Scholars and Performers**

Lider fun du getos un lagern is the foundation of music in the Holocaust. Shmerke Kaczerginski was one of the first people to document and collect these 235 songs and poems from the Nazi camps and ghettos. Kaczerginski undertook this task of collecting work because after the war almost nobody remained who would be able to attempt a fresh start at gathering and collecting works. This book includes the stories of lives and events in Lithuanian and Polish ghettos and labor camps in 1940-1944. From the displacement, dehumanization, suffering and despair to Jewish strength and self-reliance, I will be creating a version of Lider fun du getos un lagern that is available to a larger population of scholars and performers. This will be done through translating the original language of these artifacts from Yiddish to English. There will be a document with the Yiddish on one side and the English translation on the other. Since Lider fun du getos un lagern is the largest and best-regarded Shoah song compendium this research is helping to reclaim the voices of the lost people so that they may be heard fully. Through these translations we will enable a more accessible platform for these songs in order to provide a place for future scholars and performers to be able to access the text and be able to read it, learn from it, and analyze the stories within.

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**Student Authors (s):** Rose, Jacob; North Carolina School of Science And Math

**Mentors (s):** Alter, Carrie; North Carolina School of Science And Math

### **The Overflowing Mind**

The Overflowing Mind explores the relationship between art and technology, using a computer generated 3d model to create a sculpture which highlights the inner thoughts of a student. The piece was made using photogrammetry, a 3d scanning method, to create a solid model of the artist's head, which was modified using computer-aided-design (CAD) to create a lattice appearance. Over 100 photos taken from various angles of the artist's head were stitched together in photogrammetry software to create a solid model using computer vision and a mesh file system. CAD was then used to correct the computer-generated model using surface deformations to shape any errors in the mesh and edit the density of information in the model. This was further modified to create a lattice which would allow the viewer to see inside, while preserving the shape of the head. The resulting model underwent 35 hours of fused-deposition-modeling 3d printing using PLA filament and 2 hours of post processing to create the final printed object. Further work was done to hang ideas inside of the head to give the appearance of floating thoughts. Subjects, emotions, and anxieties, from math homework to personal appearance, crowd the inside of the head, representing the congested mind of a student. This thought-provoking piece examines how technology can be used to create novel works of art, blurring the line between science and art with a product that combines creative aspects of both.

## Poster Presentations

### Biological & Life Sciences

306

**Student Authors (s):** Johnson, Haley; North Carolina State University

**Mentors (s):** Kathariou, Sophia; North Carolina State University

### **The Impact of Genetic Manipulation on Virulence of Listeria Monocytogenes strains**

As a foodborne bacterial pathogen, *Listeria monocytogenes* can cause listeriosis in animal and human populations, resulting in major economic loss and even death. Common symptoms of listeriosis include diarrhea and a fever, while specific high risk populations like pregnant women experience more severe symptoms. Animals that contract this disease exhibit some of the same symptoms as humans along with being able to pass listeriosis to humans, most commonly through contaminated dairy or meat products. *L. monocytogenes* can transfer among a variety of hosts including animals, humans, soil, water, and inanimate objects like stainless steel surfaces. This ease of transferability and life span on or inside these hosts makes this bacteria readily and easily transmissible. Genetic factors that control virulence, or infectiousness, in this bacteria are not well understood, nor are the impacts of genetic manipulation on those factors. This study uses the larvae of the greater wax moth *Galleria mellonella* as a model to investigate virulence rates in different mutants or variations of the serotype 4b WS1 *L. monocytogenes* strain. The parental strain or wildtype WS1 strain was compared to eleven different mutant strains that had an altered genome and were not able to produce the exact same enzymes, proteins, etc. as the parent strain. The mutants that were tested had altered inhibition, meaning they outcompeted other bacterial cells more or less than the parent strain. After running multiple trials two mutant strains were identified as having decreased virulence levels in comparison to the parental WS1 WT strain.

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**Student Authors (s): Shah, Anshu; North Carolina School of Science And Math**

**Mentors (s): Olby, Natasha; North Carolina State University**

**Genetic Analysis of Congenital Macrothrombocytopenia in Cavalier King Charles Spaniels**

Congenital macrothrombocytopenia (MTC) is a genetically inherited blood disorder. It causes Cavalier King Charles Spaniels (CKCS) to have fewer and much larger sized platelets. These platelets, or thrombocytes, are blood cells that help to stop bleeding by sticking together to form a clot. This genetic disorder is found in 30-50% of CKCS, but usually has no symptoms or signs and doesn't require treatment. However, many CKCS are put through various unnecessary tests and treatments by veterinarians who notice the low platelet count, but forget that this common disorder is harmless in CKCS. In my review project, we analyzed a spreadsheet of genetic data collected from CKCS, filtering the surveyed populations, genes, and data. We selected the chromosomes, affected and unaffected populations, and the reference and altered nucleotides to sift through the data. Thus, we found out that macrothrombocytopenia occurs on chromosome 24 of CKCS, and by a mutation in the TUB $\beta$ 1 gene, which encodes for the beta 1 tubulin protein. This protein is used by megakaryocytes, or large bone marrow cells, for the production of blood platelets, but when mutated, it produces fewer and larger platelets. My project was a review of previous research and was confirmed by checking other papers on the disorder. Scientists and dog breeders have used this research to find out which CKCS have the disorder and how to avoid that mutated gene in breeding and in future generations of the CKCS.

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**Student Authors (s): Ford, Sade; North Carolina A&T State University**

**Mentors (s): Worku, Mulumebet; North Carolina A&T State University**

**Using NCBI PubMed to gather research articles about genes encoding ruminant galectins (LGALS 1,3,4, and 9)**

The NCBI PubMed is the largest database for medical and bioscience publications including journal articles and books. Most of the articles in PubMed database have links to records from other NCBI Entrez databases such as Nucleotide and Protein database. The objective of this project is to retrieve information from recently published articles about research conducted in (LGALS)1,3,4, and 9 of goats, sheep, and cows and the roles of those galectins in immunity and inflammation pathway. The information includes complete gene sequences, number of exons in each gene, number of variants, translated protein isoforms and their functions, gene pathways, distribution of gene expression in the animal organs. The search was conducted using the NCBI Entrez PubMed Internet interface. The search queries against the PubMed database were constructed following Entrez query role. A list of a large number of articles was extracted from the database. Filters were used to narrow down the list to only the most cited articles. When it comes to human galectin results there were 5829 studies done from 1980 to 2020. The number of articles published about galectins is 36, 65,144 for goats, sheep, and cows respectively. This concludes that there are more studies done on human galectins than goat, sheep, and cow galectin studies which means more investigations should be done in this area.

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**Student Authors (s):** Alston, Kayla; North Carolina A&T State University

**Mentors (s):** Worku, Mulumebet; North Carolina A&T State University

### **On Farm Diagnosis of Mastitis**

Mastitis is an inflammation of the mammary gland caused by infection with pathogens. It impacts dairy farm economics through medical costs, decreasing the income of milk because of discarded milk, and occasional deaths. Early detection of mastitis is important therefore, surveillance is necessary. Somatic cell count (SCC) is one way to indicate mastitis. High SCC indicates an infection from bacteria that cause mastitis. This study compares two approaches to detect SCC in milk. The California Mastitis test (CMT) is an indirect indicator for estimating SCC in milk. The test reagent (Bromocresol-purple in detergent) reacts with cell's DNA to form a gel. The gel viscosity is proportional to SC present in a milk sample. The PortaSCC® test (a portable somatic cell count-based test) measures activity of the enzyme, esterase, present in leukocytes. Studies are needed to compare the usefulness of these cow side tests on pasture Dairies in NC. We will choose 3 milking cows and check the SCC and perform a CMT. We will perform these tests on 3 different days and compare results to provide relevant results to farmers. Such studies will contribute to the development of biosensors and lab-on-chip devices for on-farm diagnosis of mastitis.

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**Student Authors (s):** Mehta, Aarav; North Carolina School of Science And Math

**Mentors (s):** Sanford, Jack; UNC Chapel Hill

### **Investigating the Role of cytoplasmic p53 in DNA damage repair**

p53 plays a very important role in the cell as a transcription factor, being able to arrest the cell cycle, trigger apoptosis and autophagy, induce DNA damage repair, and even alter the metabolism, but not as much is known about its cytoplasmic functions. This is because p53 has fewer cytoplasmic localizations in mammalian cells, with the exception of bats. Bats create large amounts of reactive oxygen species (ROS) during flight, and this can cause extensive damage to the organism's DNA. Therefore, the hypothesis for this experiment is that this cytoplasmic localization of p53 allows for a faster rate of DNA damage repair. We quantified the rate of the DNA damage repair in the mutated mouse embryonic fibroblast (MEF) cells by using  $\gamma$ -H2AX and DAPI. This allows us to visualize both the total DNA content as well as the  $\gamma$ -H2AX. We used ImageJ to quantify the fluorescence between experimental and control groups. We observed lower levels of  $\gamma$ -H2AX in the mutant p53 cell line in the 2hr, 24hr and 48hr time points. This potentially reflects more rapid DNA damage repair in the mutant MEF cell line. However, it is unclear that the experiment, measurement, and quantification worked properly because we were not expecting a lower  $\gamma$ -H2AX signal at 2 hours. Although the results possibly show a difference in the rates of DNA damage repair, this study should be replicated and the quantification technique validated, as well as additional research should be conducted about the intracellular effects of cytoplasmic p53.

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**Student Authors (s):** Gorman, Benjamin; UNC Chapel Hill

**Mentors (s):** Fitting, Sylvia; UNC Chapel Hill

**Effects of monoacylglycerol lipase inhibition on neurotoxicity of HIV Tat-exposed microglia**

While antiretroviral therapy (ART) has dramatically reduced human immunodeficiency virus type 1 (HIV-1) mortality, ART cannot eliminate viral reservoirs in the brain and thus HIV-1 associated neurocognitive disorder (HAND) persists in 30-50% of patients. HIV-1 proteins, such as transactivator of transcription (Tat), have been shown to contribute to synaptodendritic injuries and inflammation correlated with HAND. One potential therapeutic target is the endogenous cannabinoid system. Activation of cannabinoid receptors (CBR), which include CB1R, CB2R, and GPR18, have been shown to induce anti-inflammatory effects in various neurodegenerative disease models. CB2R and GPR18 are expressed on microglia, which are significant HIV reservoirs and have been implicated in HAND neuropathogenesis. These receptors are activated by a relatively novel monoacylglycerol lipase (MAGL) inhibitor through upregulation of the endocannabinoid 2-arachidonoylglycerol (2-AG). Despite potential clinical viability, the relationship between microglia, HAND, and CB2R and/or GPR18 signaling is not well understood. To elucidate the microglia-mediated indirect effects of the Tat on neuronal function, the present study uses primary microglia and prefrontal cortex neuron culture models derived from postnatal day 1 and embryonic day 15–16 CD57/BL6 mice, respectively. Microglia cultures at DIV15 are treated with Tat, ABX1431, CB2R and GPR18 antagonists. Intracellular calcium levels, dendritic morphology, and neuronal injury are measured upon exposure to secretions of treated microglia, and microglial cytokine release is quantified. We hypothesize that Tat-exposed microglia will demonstrate increased production of various proinflammatory cytokines and induce dysregulation in neuronal health, with Abx1431 treatment attenuating these effects, possibly in a CB2R- or GPR18-dependent manner.

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**Student Authors (s):** Snide, Austin; Catawba College

**Mentors (s):** Hartwig, Carmony; Catawba College

**Eggshell Organizing Factor 1 Protein in *Psorophora ferox* Mosquitoes**

Mosquitoes may serve as vectors for infective agents that cause human pathologies such as West Nile, Zika, and Malaria; and therefore controlling mosquito vector populations is an important step towards protecting human health. In a recent study by Isoe et al. (2019), researchers found that mutation of the Eggshell Organizing Factor 1 (EOF1) protein in *Aedes*, *Culex* and *Anopheles* mosquito genera resulted in 'defective' eggs that were discolored and failed to reach maturity to larvae. One genera that has not been evaluated for the EOF1 protein is *Psorophora*. The purpose of this study is to determine if the EOF1 protein is present in the species *Psorophora ferox*. This is an ideal species to study because they can be potential vectors for a variety of pathogens, they belong to the Aedini taxonomic group shared with the *Aedes* genera which possesses EOF1, and they are highly abundant in the late summer in our ecological preserve. Using published primer sequences, we tested primer combinations known to amplify EOF1 from *Anopheles*, *Aedes* and *Culex* genera on *Psorophora* extracts. A putative EOF1 gene was shown to be amplified using primer sequence EOF1-36304, and after further sequencing analysis the amplified gene was shown to be identical across each *Ps. ferox* (99.9 %) sampled thus far. Here we discuss our continued research through determination of open reading frames (ORF) of this putative gene as a way to connect this novel *Ps. ferox* gene to the published EOF1 gene.

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**Student Authors (s):** Nason, Siena; North Carolina School of Science And Math

**Mentors (s):** Bautch, Victoria; UNC Chapel Hill

**The impact of Smad6 and Smad7 in retinal angiogenesis**

The Bone Morphogenetic Protein (BMP) signaling pathway is an important regulator of angiogenesis, and Smad6 and Smad7 are key inhibitors of this pathway. Smad6 and Smad7 have a similar protein structure and are known to have overlapping functions in vitro, both inhibiting the phosphorylation of the transcriptional regulator Smad1/5/8. Previous research has also determined that Smad6 and Smad7 are important for the development of the vasculature, in particular the loss of SMAD6 results in a hemorrhage phenotype in late embryogenesis. Given their overlapping function in vitro, we hypothesize that Smad6 and Smad7 may compensate for each other in vivo, resulting in a more drastic vascular phenotype. To investigate the relationship between Smad6 and Smad7 we are using a vascular specific conditional knockout of these two genes in the postnatal mouse retina as it is a well-established model of angiogenesis. The whole-mount retinas were stained for isolectin B4 (IB4) and alpha-smooth muscle actin ( $\alpha$ SMA) to visualize the vasculature and arteries respectively. Comparing the control and double knockout retinas, we observed a significant decrease in the number of large arterial vessels stained with  $\alpha$ SMA and an increase in crossovers between the arteries and veins. We have found that loss of Smad6 and Smad7 has an impact on the remodeling of the vessels and increases the likelihood of aberrant artery and vein interactions. Further investigation is now necessary to determine the individual and joint contributions of these genes to this phenotype.

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**Student Authors (s):** Leonard, Justin; Catawba College

**Mentors (s):** Howard, Erin and Rushing, Amanda; Catawba College

**Journey to the gut: Exploring the viability of probiotic microbial migrants following gastric exposure**

The intestinal microbiota is important for nutrient metabolism, maintaining the gut immune system, and preventing gut permeability. Recent reports have even linked imbalances in gut microbiota to defective neurodevelopment and declining neural function. Given the critical roles the gut microbiota plays in human health, the maintenance of these bacterial populations is critically important. In recent years, the usage of consumer-grade probiotic supplements has increased, yet the ability for these probiotic strains to effectively colonize the gut remains a matter of debate. Non-specific host defenses, including stomach acid and digestive enzymes, help protect against pathogens and may also impair the successful migration of probiotic strains to the gut. We aim to test the viability of probiotic strains in response to physiological conditions simulating the gastric compartment. Because most probiotic products are not regulated by the Federal Food and Drug Administration, we first plan to confirm the viable bacterial content of a selection of fermented foods, like yogurt, and popular probiotic dietary supplements through culturing and 16s ribosomal RNA (rRNA) gene sequencing. Then, we will assess the in vitro viability of probiotic bacteria after exposure to experimental conditions mimicking those of the gastric compartment. We also plan to repeat 16s rRNA gene sequencing to survey the diversity of surviving strains. We predict that we will observe an overall decline in probiotic viability, as well as a reduction in diversity after simulated gastric exposure.

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**Student Authors (s):** Alvarez, Maria Paz; North Carolina State University

**Mentors (s):** Skaar, David; North Carolina State University

**Identification of Differentially-Methylated Regions Detected in Cord Blood for use as Biomarkers of Hepatocellular Carcinoma Predisposition**

Early environmental exposures to heavy metals such as cadmium may lead to the development of hepatocellular carcinoma (HCC) later on in life. Due to the low survival rate and prognosis of late-stage HCC patients, screening of genetically predisposed individuals may be effective for successful prevention and early-stage treatment of HCC. Ongoing studies are investigating the impact of developmental environmental exposures on imprinted gene regulatory methylation as a mechanism that increases HCC risk in adulthood. Using samples from two cohort studies, whole genome methylation sequencing was performed on cancerous liver tissue from non-alcoholic patients, and on blood from mothers and newborns with known heavy metal exposures.. From these studies, we identified the set of differentially methylated regions (DMRs) associated with both HCC and elevated blood cadmium. From this set, 19 DMRs that overlap putative imprinting regions in proximity to genes with endocrine and reproductive function were selected for further analysis. Targeted sequence analysis using DNA from both cohort groups was carried out to establish informative biomarkers for the detection and diagnosis of hepatocellular carcinoma. The results obtained from this analysis will be used to develop screening tools for evaluating susceptibility to the development of liver cancer.

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**Student Authors (s):** Gray, E. Malachi; Catawba College

**Mentors (s):** Bolin, Jay; Catawba College

**Genome size estimates in the genus *Iva* (Asteraceae)**

The genus *Iva* contains 9 species of herbaceous or semi woody shrubs and herbs. This genus is predominantly present in North America and the West Indies. We collected and used DNA flow cytometry to generate C values for three *Iva* species. The C value is a measure of the amount of DNA in a organism's nuclear genome. We used the C values to compare the genome for each of the collected species, which can relate to the characteristics in groups with differing ploidy levels. We are comparing the genomes of the three *Iva* spp. for comparative data to investigate genome evolution in a lost domesticated crop . The seeds of *Iva annua*, sumpweed, have been offered as a pre-maize staple food crop for indigenous Americans in the mid-western and eastern regions of the USA. The genome variation if detected in extant populations of *Iva annua* may indicate residual phenotypes of domestication.

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**Student Authors (s):** Calhoun, Cassidy; Yordanova, Desislava; Dolley, Sarah; Bridges, Brittany;

**Belmont Abbey College**

**Mentors (s):** Polnaszek, Timothy; Belmont Abbey College

### **Personality in Hissing Coackroaches**

Animal personality is an interesting, but difficult topic to study for many reasons. The main reason for this is that animals can not relay their feelings to humans. So, animal personality is studied by documenting the behaviors of one individual over time and in many different scenarios, to see if consistent personality types exist within the species. Boldness is a commonly studied aspect of animal personality. Boldness is defined as the tendency for an individual to take risks. This study examined whether there are consistent boldness between male and female hissing cockroaches in different, controlled scenarios. We placed individuals in novel arenas to see if boldness was consistent. By measuring the movements of each individual cockroach in each situation, we were able to determine where they exhibit boldness as a consistent personality type. Based on previous studies, boldness and rapid movements have been a strong indicator of out-going and “extrovert-like” personalities. We predicted that male hissing cockroaches would exhibit more boldness in a male vs. female and male vs. group scenarios. Our results show that boldness was not consistent through scenarios and changed each week, showing limited evidence for consistent personalities in this species.

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**Student Authors (s):** Wakeman, Jessica; Campbell University

**Mentors (s):** Mathews, Stephanie; Campbell University

### **Optimization of *Dunaliella salina* growth using commercial fertilizers and salts**

The halotolerant algae *Dunaliella salina* produces high levels of carotenoids, antioxidants, and fatty acids, which are required components of aquaculture feed, particularly in brine shrimp rearing. Obtaining high biomass in a low-cost medium is essential in the process of feed production. For future enhancement of *Dunaliella* biomass production, low-cost media using combinations of commercially available salt and fertilizer was compared to the medium used in current culturing methods. *D. salina* growth was observed over a range of salinities in commercial fertilizer and quantified using automatic cell counting and UV-vis spectrophotometry. Growth was then observed in an all-commercialized salt and fertilizer medium, followed by a commercialized salt and custom fertilizer medium, and characterized by UV-vis spectrophotometry. *D. salina* exhibited an optimum growth rate and cell density in 0.25M commercialized salt media with a custom fertilizer mixture. When grown with Miracle-gro fertilizer, growth rates in NaCl and commercialized salt media were equivalent and optimal at 0.50M, but with a lower cell density. The primary results of biomass, cell density, and growth rate indicate that a commercial salt and fertilizer medium shows promising potential for low-cost mass culture of *Dunaliella salina* in the aquaculture industry. Future work includes lipid and protein content analysis of algae grown in optimized salt and nutrient conditions.

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**Student Authors (s):** Vester, Caitlyn; Campbell University

**Mentors (s):** Mathews, Stephanie; Campbell University

**Microbial Diversity of Campbell University Ants**

Ants are social insects that live in symbiosis with their environment. Dense ant colonies means higher risk of infection, therefore, ants have adapted a defense system against parasites and pathogens through the production of antimicrobial secretions from their metapleural gland. This study aims to evaluate the microbial diversity of worker ants in the built environment of Campbell University. Bacteria were isolated using culture-based methods, identified using 16S rRNA sequencing, and will be assessed for antibiotic production. In the first trial,  $2.3 \times 10^3$  CFU/ant were cultured using Luria Bertani Agar incubated at 25°C from ants identified as *Solenopsis invicta*. Based on colony morphology, 8 bacteria were isolated to be identified. Of these isolates, 3 were sent for sequencing after successful 16S rRNA amplification by PCR. DNA sequencing analysis identified 3 isolates at the genus level. Two *Acinetobacter* and one *Bacillus* were isolated in this initial collection. In addition to ongoing ant collection and bacterial culturing, a comparative study to outside environments will determine if the bacteria Campbell ant species are carrying are unique to ants in other environments.

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**Student Authors (s):** Subramaniam, Lauren; Rozowski, Matt; North Carolina School of Science And Math

**Mentors (s):** Baltzegar, Jennifer; North Carolina State University

**Mitochondrial haplotype diversity and wMel frequency in a population of *Aedes aegypti* from Iquitos, Peru**

Dengue virus, an arbovirus primarily transmitted to human populations through the insect vector *Aedes aegypti*, has led to the development of a large-scale pandemic across many developing nations. These countries have primarily turned to pesticides as a means of disease control. With widespread use of these chemicals, insecticide resistance has emerged as a problem which impedes disease control. *Wolbachia*, an endosymbiotic bacteria which acts as a reproductive parasite, can be used as a method of disease control through induced cytoplasmic incompatibility methods used for rapid population spread. The presence of *Wolbachia* induces a physical toll which decreases vector fitness and reduces ability to transmit disease. Much literature currently focuses on the implementation of *Wolbachia* as an alternative to pesticides, but genetic effects of *Wolbachia* upon certain insect vector populations have not been studied. Here we describe an analysis of mitochondrial haplotype diversity of an *Aedes aegypti* population sourced from Iquitos, Peru. We also describe the determination of a baseline *Wolbachia* frequency for this population. Mitochondrial DNA is used for a genetic baseline due to a low recombination rate, low mutation rate, and high rates of maternal transmission. A loop-mediated isothermal amplification assay for *Wolbachia* strain detection is detailed in addition to polymerase chain reaction analysis due to ease of use and high accuracy rates. The ultimate goal of this study is to record the effects that the release of *Wolbachia* infected mosquitoes has on the mitochondrial haplotype diversity of a population.

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**Student Authors (s):** Lozano, Clarisel; UNC Chapel Hill

**Mentors (s):** Miller, Laura Ann; UNC Chapel Hill

### **EFFECTIVENESS OF DIFFERENT TYPES OF FACE MASKS: HOW IT CAN POTENTIALLY PREVENT THE SPREAD OF SARS-CoV-2.**

During expiratory activities, humans can expel around 40,000 droplets composed of various cell types, saliva, mucus and other secretions from the respiratory tract. Previous research has shown how respiratory infections spread via “contact” with these droplets after talking, sneezing, coughing and breathing. The probability of the spread of infection is dependent on the type of pathogen, its density in the air, and the amount of time the person inhales the pathogen. The length of time pathogens are suspended in the air (which would increase their density), depends upon the velocity and direction at which the droplet is expelled and its size. Relative humidity, temperature and ventilation in the environment are also thought to be factors that determine how long droplets can remain in the environment, increasing the likelihood of inhalation by another person. Recent studies on the transmission dynamics of SARS-CoV-2, suggests that human corona viruses are often expelled in smaller droplets. However, before 2020, little was known about the efficiency of face masks, and how they help prevent the transmission of SARS-CoV-2 in public settings. In order to quantify masks effectiveness, we used computer software analysis (ImageJ) and video recordings using Schlieren Imaging of different human expiratory activities with and without masks. When coughing while wearing a surgical mask, the maximum area as estimated from the 2D plane of focus in the video was found to be  $28 \text{ [cm]}^2$ ; whereas without a mask, droplets expanded to an area as great as  $129.2 \text{ [cm]}^2$ . Additional collected data suggests that wearing face masks significantly reduces the area and the maximum distance traveled by respiratory droplets. Future projects will focus on obtaining similar quantitative data on face shields, to later compare their efficiency with face masks.

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**Student Authors (s):** Liu, Samuel; Duke University

**Mentors (s):** Tata, Aleksandra; Duke University

### **Establishment and characterization of culture conditions for primary lung endothelial cells**

The lung contains several populations of endothelial cells (ECs) that make up different types of blood vessels including veins, arteries, and capillaries. These endothelial cell populations play a critical role in respiration by bringing blood in and out of the lungs and interacting with epithelial cells to facilitate gas exchange. Additionally, research has shown that endothelial cell interactions with other cell types in the lung affect their differentiation/ and proliferation, making the study of lung endothelial cells and their interactions important to understanding lung disease and regeneration following lung injury. However, the mechanism and the cellular cross-talk between ECs and other lung cell types are not fully understood. Recently studies have used single-cell RNA sequencing to identify several subpopulations of endothelial cells within the mouse lung. Interestingly, our own scRNA seq data revealed distinct subpopulations of ECs in the human lung. In this research project, we aim to identify potential markers, including surface proteins for different subtypes of endothelial cells in the lung, which will be used to purify subpopulations of ECs. In addition, we established a condition for isolation and culture of endothelial cells. In future studies, we aim to further characterize the culture condition for different endothelial cell subpopulations. Moreover, we will develop an in vitro co-culture system for lung epithelial cells, including AEC2 (AEC2) combined with endothelial to study functional interactions between the different cell types of the lung and to more accurately recapitulate the lung as a model system to study lung disease and regeneration.

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**Student Authors (s):** Swepson, Candace; Catawba College

**Mentors (s):** Hartwig, Carmony; Catawba College

**Investigating the Prevalence of *Dirofilaria immitis* in Mosquito Vectors from Salisbury, Rowan County, North Carolina**

The prevalence of heartworm infection in canines, especially in the southeastern United States, has increased greatly in the past few years (Drake 2018). According to the Companion Animal Parasite Council (CAPC), in 2019, 1 out of every 46 dogs in Rowan County, North Carolina, tested positive for canine *Dirofilaria immitis*, more commonly known as heartworm. This devastating disease is due to the transmission of *Dirofilaria immitis* microfilariae via the bite of a mosquito vector. At Catawba College we have a healthy ecological preserve that is surrounded by not only the campus and but neighborhoods, and has many recreational uses for not only the Catawba community, but the surrounding residents. Importantly, our preserve contains 54% of the mosquito species diversity described in the state of North Carolina, all within a mere 68 Ha (Hartwig, 2018). Several of these established species are proposed vectors for *D. immitis* transmission. Therefore, we sought to identify the prevalence of *D. immitis* in known mosquito vectors within our ecological preserve and in surrounding localities of Salisbury, North Carolina. There have been no published studies like this proposed study to our knowledge in North Carolina since the 1980s. Here we discuss the results thus far of vector-status for mosquito populations from the Catawba College Ecological Preserve using a PCR-based detection method described previously (Ferreira et al., 2015), and the long-term implications for owner education and prevention therapies.

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**Student Authors (s):** Vasudevan, Nethra; North Carolina School of Science And Math

**Mentors (s):** Aghoram, Karthik; Meredith College

**Using CRISPR-Cas9 based gene editing strategy to knock out polyphenol oxidase (PPO) enzymes in *Ocimum basilicum*.**

Sweet basil (*Ocimum basilicum*) is a culinary herb commonly used to add flavor to foods in cuisines across the globe. Most notably, the leaves of this plant are used in making the ever-popular Italian pesto. When the leaves of basil are crushed, a chemical reaction occurs called enzymatic browning, which results in an unpleasant color and a bitter taste. This is caused by polyphenol oxidases (PPOs), which are enzymes that catalyze the reaction between certain phenols and oxygen following cell damage (Taranto et al., 2017). The best way to stop this reaction from occurring by editing the genes of sweet basil so that the PPO enzyme is not expressed. Gene-editing has been used for this purpose in other fruits and vegetables, such as in the Arctic Apple®. For this to occur, the first step is to identify the gene(s) in sweet basil that code for PPO enzymes. After identification, CRISPR-Cas9 technology will be used to edit the gene(s). Food waste makes up about 30-40 percent of the food supply in the United States (U.S. Department of Agriculture [USDA], n.d.). One reason for this loss is due to blemishes and damages to food supply (USDA, n.d.). Non-browning sweet basil could contribute to lowered food waste around the world. This technology could be implemented in other fresh food items that damage and brown easily, reducing the percent of food thrown away due to imperfect looks.

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**Student Authors (s):** Siripurapu, Vaishnavi; UNC Chapel Hill

**Mentors (s):** Sud, Shivani; UNC Chapel Hill

### **Cardiac Angiosarcoma Case Reports Trends and Patterns**

Primary cardiac angiosarcomas are rare malignant neoplasms of endothelial cell origin for which clinical data and research are limited. This study aims to elucidate the clinical course and outcomes for primary cardiac angiosarcomas through a systematic review. Case reports were identified through PubMed and screened using a priori criteria for inclusion and exclusion consistent with PRISMA guidelines. We abstracted pertinent clinical data including demographic characteristics, initial presentation, diagnostic methods, treatment modality and clinical outcomes. Clinical data was analyzed with descriptive statistics and overall survival was computed using Kaplan-Meier estimates. This is an ongoing systematic review. Here we present preliminary data for 24 case reports meeting inclusion criteria. Median age at presentation was 36.5 years (mean 42 years). Symptoms at presentation were non-specific including chest pain (46%), dyspnea (46%) and cough (17%). The majority of tumors were located in the atria (79%) with a right atrial predominance (71%). Metastases at time of presentation, primarily thoracic and intracranial, were present in 37.5% of cases. Imaging primarily consisted of echocardiogram and computed tomography with only 17% of patients undergoing brain imaging. Treatment modalities included surgery directed to the primary (75%), radiation to site of primary (21%) and systemic therapy (50%). Median survival was 10 months. Primary cardiac angiosarcoma is a rare malignancy with high metastatic potential and poor prognosis. Further investigation is necessary to develop evidence-based multidisciplinary approaches to treatment. We urge providers to publish their clinical experiences to expand to shared knowledge and improve therapies for this rare disease.

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**Student Authors (s):** Skelly, Jaden; UNC Chapel Hill

**Mentors (s):** Wiles, Makala; UNC Chapel Hill

### **Characterization of *Staphylococcus aureus* (*S. aureus*) Virulence Factors**

*Staphylococcus aureus* (*S. aureus*) is a ubiquitous bacterial infectious agent that is becoming an increasingly problematic threat in hospitals and other patient care environments. Cystic fibrosis patients are particularly at risk for detrimental *S. aureus* infections, therefore the virulence factors of *S. aureus* strains found in cystic fibrosis lungs must be characterized and combatted. The abnormally viscous mucus that prevents debris to be successfully cleared creates a favorable environment for most *S. aureus* strains. Efforts to build a model of these unique lung infection sites are underway, but utilizing such a model requires a robust understanding of *S. aureus* virulence factors. This study explores the variation in virulence factor expression among *S. aureus* clinical isolate strains. The two main features being examined are staphyloxanthin, a carotenoid pigment and chemical virulence factor, and mucoidity. The combination of quantifying pigmentation extraction and identifying Mucoid or Non-mucoid phenotype within the sample strains allows for comparative analysis. The sample strains offer a wide variety of pigmentation levels while the majority of them express a non-mucoid phenotype. Strains with the mucoid phenotype show a statistically significant (p-value of 0.0414) tendency to produce less carotenoids than the non-mucoid strains. Future experiments will involve *S. aureus* biofilm production and accessory gene regulator (*agr*) function, in the hopes of finding additional correlations. Identifying these trends in virulence factor expression can pave the way to a better understanding of how the combination of these factors impacts the success of *S. aureus* strains in an infection environment.

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**Student Authors (s):** Lamb, Cooper; Watts, David; Pannick, Anna; North Carolina State University

**Mentors (s):** Paciulli, Lisa; North Carolina State University

**Characteristics of aye-ayes' (*Daubentonia madagascariensis*) huff vocalizations**

Vocalizations give information about what an individual is feeling such as fear, hunger, excitement, etc. Aye-ayes (*Daubentonia madagascariensis*) have four main vocalizations; aack, eeep, drum, and huff, but little is known about aye-aye communication. Last year, with Duke IACUC approval, a study conducted at the Duke Lemur Center examined the vocal responses of five captive aye-ayes' to a novel object in their enclosures for five minutes. It was found that significantly more "huffs" (n=57) were emitted than any other vocalization (Watts & Paciulli in prep.). The huffs were interpreted as the aye-ayes being distressed when the novel object was present. In this study, the physical characteristics of those huffs were examined. Spectrograms of the vocalizations were shown in Adobe Audition, and the peak amplitude, frequency, and loudness were noted. Thus far, the results showed that the average peak amplitude of the huffs was -24.56 Hz, the frequency ranged between 121.42 Hz and 126.48 Hz, and the average loudness was -32.23 dB. These characteristics are within the range of other primates' calls. Previously, huffs were viewed as a sign of distress, however, because huffs do not seem to originate from the vocal cords, they may not be a vocalization. Rather, huffs may be a sound made when aye-ayes clear their nasal passage to then breathe-in more air / scent like dogs do as an environmental investigatory technique. Future research should investigate the anatomy aye-ayes use to generate huffs to help elucidate their nature and function.

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**Student Authors (s):** Abernathy, Callahan; Houser, Savannah; Gandhi, Prem; Gaston College

**Mentors (s):** Williams, Patricia; Gaston College

**Mapping of Microbial Populations and Antibiotic Resistance Across Surface Water along the Catawba River Basin**

According to the Centers for Disease Control, antibiotic-resistant infectious diseases account for more than 35,000 deaths in the US annually. Multidrug-resistant strains of clinically relevant bacteria are becoming increasingly common, while the antibiotic drug development pipeline is drying up. Only recently has research begun to focus on antibiotic-resistant bacteria in environmental samples as a contributor to this growing problem. Wastewater treatment plants (WWTPs) may act as a potential vector for environmental resistance in surface water microbial communities. Research has shown that samples taken downstream from wastewater effluent release contain higher levels of antibiotics, as well as antibiotic resistance gene markers when compared to their upstream, pre-treatment counterparts. This study was conducted to provide baseline measurements of the antibacterial resistant profile of 12 sites on the Catawba River, a North Carolina River System that acts as the primary source of drinking water for the Charlotte-Mecklenburg region. Samples were collected from 12 sites on the river, and the resistance of isolated bacterial colonies was tested using Disk Diffusion. The antimicrobial compounds used in the tests made up a range of commonly used antibiotic drug classes. Further research efforts in this study will include sequencing of bacterial sample DNA to identify bacterial species and resistance genes.

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**Student Authors (s):** Kerns, Elizabeth; Cooper, Cameron; Hernandez, Emmanuel; Belmont Abbey College

**Mentors (s):** Polnaszek, Timothy; Belmont Abbey College

**Female Hissing Cockroaches Food Preference**

Studies have reported that the Madagascar Hissing Cockroach *Gromphadorhina portentosa* has sex-specific food preferences. In particular, the females require more protein for fertility and egg development while the males require more energy from carbohydrates to fuel their neuromuscular systems for their higher amounts of aggression and mobility. Here we studied female *G. portentosa* and their preference to fruit with varying protein amounts. The previous studies suggest that the females should prefer the fruit with higher protein levels. Our results suggest that individual cockroaches may have different food preferences that are inconsistent within the population, regardless of the protein content. Future studies could identify factors that influence the individuals' differences in preference. Additionally, they may test whether the preference is repeatable by experimenting with the same individuals across weeks.

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**Student Authors (s):** Stokes,Ruthie; North Carolina Central University

**Mentors (s):** Fleming, Jodie; North Carolina Central University

**The Optimization of Immunohistochemical Analyses of Breast Cancer Tumors Post ECM Degradation**

42,260 deaths were caused by breast cancer (BC) in 2019. The same year also found that around 31% of all BC cases were over-diagnosed, leading to overtreatment and in some cases death. BC has a range of targeted therapies for treatment, but BC is not black or white. Grey areas known as subtypes require more aggressive treatments due to the lack of targeted therapies for particular subtypes. The problem is tumors are smart and utilize their extracellular matrix (ECM) to encapsulate them, which prevents Chemotherapeutics from penetrating into the tumor for tumor eradication. Attempts to use ECM degrading enzymes on the ECM to enhance chemotherapeutic drug effectiveness on the tumor is currently on going. Our project focuses on understanding the ECM via proteomics, rheology, immunohistochemical and other biomedical analysis. We use a thermoresponsive, targeted injectable drug delivery system to deliver enzymes and drugs into the tumor to affect the ECM and tumor viability. Here, we specially focus on the optimization of immunohistochemical analyses to measure the levels and types of collagen in BC tumors, their composition post-treatment with ECM degradation drugs or controls. The goal is to identify which ECM degradation enzymes will be effective in softening tumor ECM thereby enhancing sensitivity to chemotherapeutic drug treatment. Our goal is to effectively soften the ECM through direct injection of collagenase mixed with a chemotherapeutic drug cocktail via the thermoresponsive targeted injectable drug delivery system to allow targeted delivery directly to the tumor site.

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**Student Authors (s):** Pandya, Nisha; North Carolina State University

**Mentors (s):** Godwin, John; North Carolina State University

**Phenotypic consistency in stress coping styles in selectively-bred zebrafish (Danio rerio)**

Mental health disorders are an important research topic due to their prevalence. Approximately 19% of individuals in the US experience an anxiety disorder. We are using zebrafish (*Danio rerio*) as models to study stress coping styles. There are two primary stress coping styles that are typically observed in vertebrates: termed proactive and reactive. Prior work found that these two distinct coping styles were present in selectively-bred proactive and reactive zebrafish lines. Additionally, the prior work compared neural gene expression profiles between zebrafish bred to exhibit one of these two coping styles. The current study will provide a comparison to the previous work using fish bred from original parents captured from a different location in India. Comparing this study to the results of the previous work will provide insight into potential parallel changes in the evolutionary paths to divergent stress coping styles. We hypothesize that the phenotypic consistency will be significant when comparing the different sets of zebrafish from the current study to the previous work. Results showed that the differences in coping styles, for both populations, were significant. The evolutionary phenotypic consistency, through the use of artificial selection, between the different populations indicates a potential presence of parallel evolution. The next step is to identify the gene expression profiles to further understand the mechanisms underlying anxiety disorders in humans.

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**Student Authors (s):** Tesch, Amy; Pegram, Andrew; Belmont Abbey College

**Mentors (s):** Polnaszek, Timothy; Belmont Abbey College

**Social Interaction and Aggression in *Gromphadorhina portentosa* as related to food availability**

Food deprivation in humans often causes an increase in aggression. There have been studies of other species that show food deprivation to have an opposite effect. For instance, a study on *Drosophila melanogaster* (Wang, Sokolowski, 2017) showed aggression levels to decrease when an individual was food deprived. The aim of this study is to determine the effect food deprivation has on *Gromphadorhina portentosa*. We predict that the cockroaches who experience food deprivation will show more aggression than those that do not because the cockroaches experience an increase in stress. For the experiment each cockroach is randomly put into one of two groups. One group is given food the entire course of the study while the other group only has access to food on certain days during the week. The food is removed 4 days before observation for the first two weeks of the experiment, and for the second half the food is removed one day before observation. During the period of observation we record three different behaviors: moving towards one another, climbing on top of one another, and fighting with one another. We note whether the instigator is food deprived or not as well as the recipient. The results thus far indicate that the food deprived cockroaches show not only less aggression than their regularly fed counterparts, but less activity overall, regardless of the period without food.

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**Student Authors (s):** Azad, Rasheeq; North Carolina School of Science And Math

**Mentors (s):** Falvo, Michael; UNC Chapel Hill

**Optimizing SPIM-FRAP Image Analysis to Track Molecular Movement Inside HeLa Cell Nuclei**

The combination of selective plane illumination microscopy (SPIM) and fluorescence recovery after photobleaching (FRAP) allows for the diffusion constant of a chosen molecule to be mapped throughout a cross-section of a living cell. This combination technique is promising for exploring the inner dynamics of cells; however, it has a major limitation in that the original SPIM-FRAP software routine (implemented in Mathematica) is very slow. This bottleneck makes it difficult to analyze more than a handful of data sets in a day. We try to improve the performance of the analysis, in the hopes that it can be used to process more data. We reimplement the SPIM-FRAP software routine to operate on a CUDA-enabled GPU (programmed in Python using Numba), processing pixels in parallel. We also test the new routine against image sequences of 53BP1-mCherry (a protein associated with DNA damage repair with a fluorescent tag) and NLS-GFP in transgenic HeLa cells placed under mechanical stress with an atomic force microscope. The new SPIM-FRAP routine uses its own implementation of the Levenberg–Marquardt nonlinear least squares regression. We report a speedup of several orders of magnitude, processing each dataset (each about 5000 pixels over 400 frames) in times on the order of one second, as opposed to the original twenty minutes. This speed makes SPIM-FRAP a more useful tool for exploring cell mechanics, as results can be retrieved almost as soon as data is available.

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**Student Authors (s): Williams, Demonnie; Peralta, Ariane; East Carolina University**

**Mentors (s): Peralta, Ariane; East Carolina University**

**Nutrient enrichment directly and indirectly influences wetland plant-microbe relationships**

Microbes carry out critical ecosystem functions such as metabolizing compounds to make nutrients accessible for other organisms. For example, soil microbes provide plants with nutrients as well as producing hormones that induce plant growth. Plants also provide the soil microbes with carbon resources in the form of photosynthates released through root exudates. However, changes to the soil environment can disrupt this beneficial plant-microbe relationship. In this study, we examined how changes to soil carbon resources and nutrients affect plant and soil bacterial communities. We hypothesize that nutrient enrichment disrupts positive plant-microbe relationships. We predict that plant and microbial patterns will be associated in unfertilized but not fertilized wetland conditions, due to there being a greater positive plant-microbe relationship within the unfertilized compared to fertilized wetland plots. We test this hypothesis using a long-term study conducted at East Carolina University's West Research Campus. The experiment investigates how fertilizer addition and mowing affect a coastal plain wetland ecosystem. In fertilized and unfertilized mowed plots, we used annual plant survey data and soil bacterial 16S rRNA amplicon sequencing to analyze the plant-microbe relationships. Results also showed that bacterial diversity was negatively related to plant diversity in the fertilized wetland plots but not in the unfertilized plots. These results suggest that nutrient additions weakened the plant-microbe relationships within this nutrient-poor wetland. Nutrient enrichment is ongoing due to many human activities such as agriculture, and this nonpoint source pollution can alter community patterns independently, as well as the interactions between plants and microbes.

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**Student Authors (s): Williams, Anna; East Carolina University**

**Mentors (s): Ables, Elizabeth; East Carolina University**

**Ran regulates germ cell mitotic divisions in *Drosophila***

The creation and maintenance of germ cell cysts are crucial for oocyte viability. As a model to study germ cell formation and differentiation, *Drosophila melanogaster* germ cells, undergo exactly four mitotic divisions with incomplete cytokinesis to create germ cell cysts with 16 cells. One germ cell is specified as the oocyte, while the others retain a nurse cell fate. Incomplete cytokinesis leads to cyst interconnectivity, crucial for cell communication and subsequent oocyte selection. The mechanisms promoting cyst formation, in mammals or insects, remains largely unknown. Previous studies uncovered a novel role for the karyopherin Transportin-Serine/Arginine rich (Tnpo-SR) in germ cell mitotic divisions. Karyopherins transport proteins across the nuclear membrane, impacting cell functions. To test whether the role of Tnpo-SR in germ cells was indicative of a more general function of karyopherins in mitotic division, we performed a reverse genetic screen, using germline-enhanced RNAi to knock-down germ cell expression of eight of the eleven  $\beta$ -importins encoded in the *Drosophila* genome. Intriguingly, only four  $\beta$ -importins produced germ cell phenotypes; moreover, loss-of-function of two  $\beta$ -importins, Cadmus and Tnpo-SR, and Ran, the facilitator of nucleocytoplasmic transport, phenocopied each other, displaying oocyte loss, improper cyst formation, and germ cell tumors. Our phenotypic analyses suggest that Ran, via Cadmus and Tnpo-SR, suppress incomplete cytokinesis in cysts. We are currently investigating the relationship between these factors to determine what potential protein cargoes are transported. These results shed new light on the molecular mechanisms controlling germ cell mitotic divisions and interconnectivity, postulating similar roles for Ran in humans.

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**Student Authors (s):** Wiitala, Jasmine; Malul, Oryan; Catawba College

**Mentors (s):** Rushing, Amanda; Catawba College

**Soil sleuthing: student-sourcing the antibiotic discovery pipeline**

In the microscopic world, bacteria have long been waging war against each other. In their competition for resources, many bacteria have evolved the ability to use chemical weapons that target the physiological processes of competing bacteria. Today, we know these weapons as antibiotics and regularly use them to treat bacterial infections in humans. However, overuse of these drugs has created new strains of antibiotic-resistant “super-bugs,” some of which are impervious to many of the antibiotics that are currently approved for therapeutic use. As resistant strains continue to emerge, it is imperative that we develop effective alternatives. In the past, *Acinetobacter*, a group of bacteria commonly found in the soil, has been an excellent source of novel antibiotic compounds. However, it is estimated that less than 1% of *Actinobacteria* species have actually been identified, suggesting the possibility that new sources of antibiotics are living in the ground beneath our feet. Our project aims to evaluate antibiotic production in bacteria isolated from locally-obtained soil samples. Antibiotic-producers will be established in pure culture for further identification by 16s rRNA sequencing and metabolic testing. Antibiotic compounds will then be extracted for further confirmatory testing, and results will be logged in an international database curated by Tiny Earth, a research program based at the University of Wisconsin-Madison.

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**Student Authors (s):** Walters, Abigail; McLamb, Kasey; Catawba College

**Mentors (s):** Howard, Erin; Catawba College

***Daphnia pulex* reproduction in response to BPA and BPA derivatives**

Bisphenol A (BPA) is an industrial chemical used in the formation of polycarbonate plastics and epoxy resins, which are used in the manufacturing of food packaging and water bottles. BPA has been shown to mimic the hormone estrogen, allowing it to react with estrogen receptors and affect their function. Previous research has shown that exposure to BPA through food and beverage packaging can increase the risk of adverse health effects on the brain, prostate gland, mammary glands, behavior, and reproduction. Thus, BPA was banned from the manufacturing of everyday plastics, but was promptly replaced with BPA derivatives, like BPAF and BPS, which were thought to be more stable than BPA. However, these BPA replacements may have more potent consequences on human health. This research project aims to investigate the reproductive effects of BPA and BPA derivative on *Daphnia pulex*. *D. pulex* are freshwater crustaceans that are used in research for their easy reproducibility and sensitivity to toxins. Previous studies have not examined the reproductive effects of BPA and BPA derivatives in *D. pulex*. Thus, we will examine the effects of BPA, BPAF, and BPS in varying concentrations on the reproduction rates and age of sexual maturity. Due to the estrogenic effects of BPA and BPA derivatives, we expect that reproduction rates will increase and *D. pulex* will reach sexual maturity earlier when exposed to BPA and BPA derivatives. The results of our findings could indicate possible impacts on the *D. pulex* population, freshwater ecosystems, and human health.

**Student Authors (s):** Stiller, Amber; UNC Charlotte

**Mentors (s):** Song, Bao-Hua; UNC Charlotte

**Plant Power: A chemical bridge between legume phytochemicals and human health in fighting global pandemics**

Human health equipped with a strong immune system is crucial in an era battling unpredictable global pandemics, such as the COVID-19 virus. Altering human diets to include fresh fruits and vegetables rich in phytochemicals can greatly improve our immune systems and reduce the severity of symptoms for COVID-19 and other viruses. Phytochemicals, such as formononetin, glyceollin, daidzein, genistein, and glycitein, are secondary compounds naturally produced by plants. These compounds are proven to have a variety of human health benefits and are used as alternative medicines. However, phytochemicals are low in concentration. Exposing plants to stress has shown to increase the production of these beneficial compounds in plant tissues, therefore bolstering the amount consumed in our daily diet. We hypothesize that alfalfa and sweet peas, our daily smoothie and salad components, will increase the production of formononetin, glyceollin, daidzein, genistein, and glycitein when exposed to water stress, heat stress, and a combination of these in shoot samples. To test this hypothesis, the plants of interest will be exposed to each stress. Afterwards, phytochemicals will be extracted from shoot samples for each group and quantified using High Performance Liquid Chromatography. This experiment is significant because, if phytochemicals are significantly induced in the experimental group compared to the control, agricultural practices can be modified by placing stress on crops to increase phytochemical concentrations in produce. With this insight, improved diets together with altered agricultural practices could significantly influence human health and enhance our immune system to fight off ailments and unpredicted pandemic diseases.

**Student Authors (s):** Stanley, Karly; UNC Chapel Hill

**Mentors (s):** Hathaway, Nate; UNC Chapel Hill

**Determining the Role of HRP2 in Cytoskeletal Dynamics**

Cellular senescence is a tumor-suppressor mechanism that prevents the proliferation of cancerous cells by forcing cells into a state of permanent cell cycle arrest. Common characteristics of senescent cells include abnormal cell morphology and increased expression of the cyclin-dependent kinase inhibitor, p16. We have previously identified HRP2 as a novel protein in the HP1 heterochromatin formation pathway, a pathway capable of epigenetically altering gene expression. Upon further experimentation to better characterize the HRP2, the breast cancer cell line MDA-MB-231 was infected with wildtype HRP2. Cells stably expressing HRP2 exhibited a loss in motility as well as an abnormal cell morphology resembling that of senescent cells. The abnormal morphology and impaired metastasis observed in cells expressing HRP2, combined with our identification of HRP2 as a putative member of the HP1 pathway, suggest that HRP2 may be acting with HP1 to form senescence-associated heterochromatic foci (SAHF), which promote p16 expression and drive cells into premature senescence. A better understanding of the mechanistic function of HRP2 as a chromatin modulator may clarify the processes of this cellular stress-response pathway and lead to the development of novel therapeutics to treat diseases such as cancer.

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**Student Authors (s): St. John, Peyton; High Point University**

**Mentors (s): Crater, Dinene; High Point University**

**Analysis of GerE Binding to the Promoter Regions of cot Genes that are Required for Sporulation in *Bacillus subtilis***

*Bacillus subtilis* is a gram-positive organism that is able to undergo sporulation when placed under environmental stress. Sporulation in *B. subtilis* is regulated through transcription control. The DNA binding protein GerE regulates transcription in the later stages of sporulation by interacting with the sigma-K associated RNA polymerase. The focus of our research is to determine if GerE represses transcription of specific genes that are required for the synthesis of the spore coat in *B. subtilis*. We hypothesized that GerE binds to specific sites on promoter regions of *cotA*, *cotE*, and *cotH*, therefore repressing transcription. To determine if GerE can bind to the promoter regions, *gerE* was cloned into pET28a and expressed in *Escherichia coli*. Purification using the miniprep protocol under native conditions of the QIA expressionist kit (Qiagen) gave inconsistent Electrophoretic Mobility Shift Assay (EMSA) results. Our current focus is to use the QIAexpress Ni-NTA Fast Start kit to purify GerE from *E. coli*. With this new method, we anticipate a higher protein yield and a cleaner preparation, which should affect GerE's ability to bind DNA. We will then use this new preparation of GerE in EMSA reactions to show binding of GerE to the sigK promoter as a positive control. Future plans will be to ensure our new purification method enables GerE to bind to GerE-activated promoters such as *cotC* and *cotX*, as well as showing that GerE can bind to *cotA*, *cotE*, and *cotH*, allowing the repression of transcription during sporulation.

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**Student Authors (s): Smith, Courtney; North Carolina State University**

**Mentors (s): Youngsteadt, Elsa; North Carolina State University**

**Carpenter bee nesting preferences in benches on NC State University campus**

Eastern carpenter bees (*Xylocopa virginica*) excavate nests into wood, including lumber used in buildings and other structures. They may cause structural or aesthetic damage by boring holes into wooden structures and attracting woodpeckers. However, carpenter bee nesting preference are poorly known, so it is unclear which parts of structures are most at risk. Thus, we surveyed one hundred and seven benches on NC State University campus in Raleigh, NC to determine whether carpenter bees have particular nest preferences in and around structures. We searched for benches on campus and recorded the number of carpenter bee nests within them along with the length, width, and thickness of each wooden board. We recorded the distance and direction to the nearest building. Further, we recorded the presence of roofs or shelters, the compass heading of each bench, and substrate underneath each bench. We used the Solar Pathfinder™ and Sunpath software to determine the amount of solar radiation that each bench received throughout each month of the year. Nest density ranged from 0 to 66 nests per bench (0 - 45 nests per m<sup>2</sup> of wood surface). The most occupied benches tended to be under a roof or shelter, placed over soil or vegetation, and received more summer sunshine. Documenting nest site characteristics of carpenter bees may ultimately predict which parts of structures are at risk of damage and help guide homeowners in scouting and managing these insects.

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**Student Authors (s):** Sharma, Annika; Grebe, Nicholas; Duke University

**Mentors (s):** Drea, Christine; Duke University

**Comparative oxytocin and vasopressin neurocircuitry in relation to mating system in Eulemur**

Contemporary theory on the role of oxytocin and vasopressin in mammalian social bonds has been shaped by seminal vole research that revealed interspecific variation in neuroendocrine circuitry by mating system. The Eulemur genus of strepsirrhine primates contains socially monogamous (MO) and non-monogamous (NM) species, making it the sole primate analog to *Microtus*, and offering a rare opportunity for comparative nonapeptide research with greater evolutionary relevance to humans. Relying on natural mortality, we performed oxytocin and arginine vasopressin 1a receptor (OXTR; AVPR1a) autoradiography on 12 Eulemur brains (4 MO; 8 NM), representing seven species, to characterize OXTR/AVPR1a distributions across species and compare variation in receptor distributions as a function of mating system. Consistent with the 'intermediary' phylogenetic placement of strepsirrhines, some OXTR/AVPR1a binding patterns were reminiscent of olfactory-guided rodents and others were congruent with more visually oriented haplorhines. By mating system, several nuclei showed differential receptor expression, potentially consistent with a role for both neuropeptides in monogamy, but most areas previously identified as part of a rodent 'pair-bonding circuit' did not exhibit comparable differential receptor expression in Eulemur. Circuits identified as key to pair-bonding in rodents cannot be directly invoked to explain pair-bonding in primates. Mapping neurocircuitry in non-model species informs evolutionary mechanisms and neurobiological bases underlying diversity in primate social systems, and studies in nonhuman primates may serve as a valuable bridge for translating findings in rodents to human biology and sociality.

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**Student Authors (s):** Schenck, Shelby; North Carolina State University

**Mentors (s):** Sikes, Michael; North Carolina State University

**The role of Upstream Stimulatory Factor in B cell activation**

Our population of B lymphocytes, each with its own receptor specific for an individual antigen, gives humans the potential to produce specific antibodies against a near limitless array of infectious agents. Activation of a B cell upon binding its target antigen occurs in the germinal center of a lymph node and induces cell proliferation and mutation-dependent refining of the antigen receptor (antibody) coding sequence to optimize antigen binding. Because dysregulation of B cell activation can lead to immune defects including cancer, it is essential to map the molecular programs that regulate activation. Our laboratory previously found that Upstream stimulatory factor (USF), a stress-response transcription factor that can act as a tumor suppressor, also helps regulate the lymphocyte response to DNA damage. Since B cell activation involves transient DNA damage during mutation of the antigen receptor genes, this project investigates the working hypothesis that USF coordinates the response of B cells to activation-induced DNA breaks. In preliminary experiments, mouse M12 germinal center B cell cultures were depleted of USF1 and USF2 by RNAi and their transcriptome analysed by RNA microarray before and after exposure to DNA damaging ionizing radiation, which showed that loss of USF preferentially altered the expression of genes involved in B-cell activation and DNA repair, particularly leading to overexpression of the gene that encodes the activation-induced DNA mutator responsible for antigen receptor refining. Findings were validated by RT-qPCR, suggesting USF is a key component of the machinery that ensures B cells are competent for antigen-dependent activation. Work is continuing to define the scope of this coordination by determining how loss of USF affects the responses to activation-induced DNA damage including apoptosis, cell cycle arrest, and DNA break repair. Together, these experiments will provide new insights on the mechanisms that activated B cells use to prevent lymphomagenesis.

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**Student Authors (s):** Ross, Madeline; North Carolina State University

**Mentors (s):** Meitzen, John; North Carolina State University

### **Postpartum Depression: A Healthcare Provider's Perspective**

Postpartum depression (PPD) is a debilitating disease that affects 10-20% of women worldwide. Women with PPD develop symptoms of Major Depressive Disorder during pregnancy and postpartum, which can deleteriously affect maternal and nurturing behaviors, harm mother-child relationships, and lead to negative child outcomes. This study examines PPD from the perspective of healthcare providers to provide insight into the roles of physicians, families of affected women, and the community in prevention, diagnosis, and treatment of PPD. To learn how physicians from multiple specialties manage a complex and widespread disease, interviews were conducted with four healthcare providers including an obstetrician gynecologist, psychiatrist, and two pediatricians. Responses were transcribed for comparison and analysis. The results suggest the importance of future research examining postpartum anxiety and its relation to PPD as well as the possible benefits of spousal support and paternity leave in reducing the risk and severity of the disorder. Additionally, they identify a need for more community resources dedicated to providing support for new mothers and women with PPD. Overall, this study provides perspective on the importance of prevention and early intervention and offers critical avenues of future research that could improve care for women affected by PPD.

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**Student Authors (s):** Robinson, Nicole; Fayetteville State University

**Mentors (s):** AbuBakr, Samer; Fayetteville State University

### **Investigating Antibiotic Resistance in Soil Bacteria: Aminobacter, Frigoribacterium, Microbacterium, Paenarthrobacter, & Rhizobium**

Soil is one of the biggest reservoirs of microbial diversity and is also considered a favorable environment for the adaptation and development of antimicrobial resistance within bacteria, which is due to its high complexity and ongoing competition between the microorganismal communities. Bacteria are microorganisms that have the ability to reproduce by doubling through a process called binary fission. These microorganisms can also mutate and/or gain mutant genes through vertical transfer (i.e. passed down by generations), horizontal transfer (i.e. bacteria to bacteria via a conjugation pilus), or viral transfer (bacterial DNA-carrying virus injecting the genetic material into a supposed bacterial host). Regarding mutation, bacteria can develop antibiotic resistance which come in the form of antibiotic resistant [AR] genes, thus giving the bacterial species an advantage of surviving the presence of antibiotics. In tandem, the ability of antibiotic resistance in conjunction with binary fission and other routes of obtaining parental DNA, this gives bacteria to become resistant at an alarming rate which has caused the antibiotic crisis on a global scale. In this research project, 13 bacterial strains that were isolated from Fayetteville State University soil (Yuan et al., 2020) will be tested for antibiotic resistance and screened for the presence of genes that encode this resistance. The 13 bacterial strains include 10 genera in which 5 are gram-positive: Microbacterium, Nakamurella, Frigoribacterium, Bacillus, and Paenarthrobacter, and 5 are gram-negative: Brevundimonas, Flavobacterium, Pseudomonas, Rhizobium, and Aminobacter.

**Student Authors (s): Robinson, Caroline; Fayetteville State University**

**Mentors (s): AbuBakr, Samer; Fayetteville State University**

**Investigating Antibiotic Resistance in Soil Bacteria: *Bacillus*, *Brevundimonas*, *Flavobacterium*, *Nakamurella*, and *Pseudomonas***

Antibiotic resistance is a growing concern worldwide. According to medical author, William C. Shiel Jr., antibiotic resistance (aka drug resistance or antimicrobial resistance) is "The ability of bacteria and other microorganisms to resist the effects of an antibiotic to which they were once sensitive." The Centers for Disease Control and Prevention (CDC) has classified several bacteria as an urgent, serious threat which has placed a substantial clinical and financial burden on the healthcare system, patients, and the patients' families (Ventola, 2015). Studies have shown that bacteria such as *Staphylococcus*, *Shigella*, *Streptococcus*, and *Enterococcus* (to name a few), have become resistant to antibiotics penicillin, tetracycline, erythromycin, and gentamicin, respectively. Antibiotic resistance in bacteria is occurring at a rapid rate. In a past research project (Yuan et al., 2020), identification of soil bacteria from Fayetteville State University's campus fields had been accomplished; thirteen strains made up ten genera of the identified soil bacteria: *Aminobacter*, *Bacillus*, *Brevundimonas*, *Flavobacterium*, *Frigoribacterium*, *Microbacterium*, *Nakamurella*, *Paenarthrobacter*, *Pseudomonas*, and *Rhizobium*. In this research project five chosen genera from the identified ten will be researched for antibiotic resistance through an extensive, literature review. The five chosen bacterial species [one from each chosen genus] that will be studied are *Bacillus subtilis*, *Brevundimonas albigilva*, *Flavobacterium anhuiense*, *Nakamurella endophytica*, and *Pseudomonas putida*. In a future project, six of the thirteen identified bacterial strains from the past project will be tested further for antibiotic resistance.

**Student Authors (s): Reid, Charnece; North Carolina State University**

**Mentors (s): Sikes, Michael; North Carolina State University**

**The Role of Upstream Stimulatory Factor on Critical Infection-Response Genes**

*Helicobacter pylori* (*H. pylori*) is associated with roughly 75% of all gastric cancers, including gastric B cell lymphoma. Persistent *H. pylori* infection leads to dysregulation of critical B cell genes, including tumor suppressor transcription factor, p53, and B cell-specific DNA mutator activation-induced cytidine deaminase (AID). Previous work showed DNA damage directs long-lasting changes in upstream stimulatory factor (USF) activity, which is required for p53 expression. To test if loss of USF activity in response to persistent stress induces the cancer-promoting changes in genes like p53 and AID, USF was knocked down in mouse MEL and M12 germinal B cell lines by RNAi. Changes in gene expression were measured by RNA Microarray and RT-qPCR before and after induction of DNA damage. USF knockdown cells showed widespread changes in gene expression 7 days after DNA damage. Differentially expressed genes fell into two broad categories of biological processes: USF knockdown cells had altered expression of lymphocyte-specific genes, and failed to induce or suppress genes associated with DNA damage and repair. Specifically, AID was dramatically overexpressed and p53 was suppressed. Work is underway to measure the response of USF knockdown cells to *H. pylori* or its pathogenicity factors. This project will provide insight to how *H. pylori* affects transcription factors like USF, and will influence cancer research, clarifying the association of B-cells with gastric cancer.

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**Student Authors (s):** Paul, Ayana; Duke University

**Mentors (s):** Tenor, Jennifer; Duke University

### **An Examination of Heredity in Sporulation Patterns in *Cryptococcus neoformans***

Recent inquiry has been made in the possibility of heritable virulent characteristics within pathogenic microbes. One infectious microbe of interest is the human pathogenic fungus, *Cryptococcus neoformans* that causes meningoencephalitis and is the most common pathogen observed in AIDS patients in sub-saharan Africa. Several strains within *Cryptococcus neoformans* vary in their ability to cause disease in a host but little is known of whether or not the genetic determinants of virulent traits can be crossed over into diploid cells that possibly result in a more severe disease. Much of the research will be focused in defining the possibility of the heritable virulent characteristics within pathogenic microbes of *Cryptococcus* strains-with a particular emphasis on sporulation patterns. Initially, seven known virulent strains that are MAT $\alpha$  (fungal mating type) were crossed with fifty 50 known and unknown avirulent MAT $\alpha$  strains to identify successful mating pairs. Results from this experiment identified the MAT $\alpha$  strains that were to be assessed for virulence in a mouse model for cryptococcosis (genotype/phenotype). The following experiments assessed the extent of sporulation between mating aggressive and nonaggressive strains. Many of these crosses presented more aggressive sporulation than others but these crosses still need to be analyzed for the presence of inherited MAT $\alpha$  genes and a virulent phenotype. Due to current public health circumstances, the progeny of these mating pairs have not been genetically screened for virulent heredity and analyzed for both for their fungal burden and virulence through the use of a zebrafish and/or mouse model.

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**Student Authors (s):** Nelson, Caroline; UNC Greensboro

**Mentors (s):** Patel, Yashomati; UNC Greensboro

### **Metabolic Regulation in Breast Cancer Cells using the Grapefruit Flavonoid Naringenin**

Breast cancer impacts one in every eight women. Central to tumor malignancy is the Warburg effect, which is characterized by an increase in glucose metabolism, and the production of lactate in the presence of sufficient oxygen to perform aerobic respiration. Approximately 70% of all breast cancers are estrogen receptor positive (ER+), and are dependent on the hormone for proliferation. Tamoxifen, a popular drug used to treat breast cancer is a selective estrogen receptor modulator and has been an effective treatment for patients that have ER+ breast cancer. However, many patients develop a resistance to the treatment. The flavanone naringenin has been found to alter cellular metabolism in a way that is beneficial for normal cells, but harmful for tamoxifen resistant breast cancer cells. The elucidation of the mechanisms through which naringenin produces its effects are a preliminary step to finding a therapeutic use for the compound in the treatment of breast cancer. Our studies used SDS PAGE and Western Blot techniques to analyze estrogen receptors and related receptors that are critical to the metabolic processes of cancer cells. Though the mechanism by which naringenin produces its effects are not yet fully understood, we hypothesized that the flavanone produces its effects through inducing anaerobic respiration. Our experiments found that the relative concentration of the estrogen receptors and related receptors decreased in the presence of naringenin, which could be an indication of the reversal of the Warburg effect. Our findings support the potential use of naringenin as a therapeutic agent.

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**Student Authors (s):** Nellom, Dy'Monique; Flowers, Laura; Chesson, Quamon;

**Elizabeth City State University**

**Mentors (s):** Young, Margaret; **Elizabeth City State University**

**Gamma rays treated Clary Sage (*Salvia sclarea*) for NaCl tolerance**

Clary sage (*Salvia sclarea* L.) is one of the most important aromatic plants used for essential oils. It is grown in Northeastern North Carolina. Some benefits include use in perfume and flavoring. It also has medicinal properties including uses for certain digestive disorders. Development of salt tolerant varieties is important as climate change is causing oceans to rise. The objective of this experiment was to treat mutated Clary sage plants with salt (NaCl) in order to find resistant lines. M2 seed lines and a control line were grown after the seeds were treated with gamma rays (170 Gy). After 4 months, half of the lines were treated with 250 mM of NaCl three times a week for one week; the other groups were treated with water. The concentration of the NaCl increased to 1M. Data were taken on survival, leaf necrosis, and plant height. All the leaves of the control plants were necrotic after 1M NaCl treatment. The majority of the M2 lines were necrotic with only 17% surviving the salt treatment. These plants will be observed for flowering and seed formation. The M3 lines will be investigated for salt tolerance. Future experiments will involve DNA profiles of surviving plants

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**Student Authors (s):** Nandwani, Jaan; **Duke University**

**Mentors (s):** Calakos, Nicole; **Duke University**

**Brain Region Specific Differences in eIF2alpha/p-eIF2alpha Levels in Early Development**

Dystonia is a movement disorder associated with sustained postures and involuntary movements. Although dystonia is the third most common movement disorder seen in clinical practice, the exact mechanisms of dystonia are poorly understood. Previous research on dystonia has suggested a role for phospho-eIF2a pathway activity in the brain as a major source of dysfunction. We hypothesize that in dystonia there is weakened eIF2alpha phosphorylation resulting in an inability for cells to properly respond to cellular stress and disrupted synaptic plasticity. The goal of this study was to identify the brain regions early in development in which the pathway's activation is disrupted in a DYT1 mouse model of childhood-onset dystonia. Western Blot analysis was used to determine the expression levels of phospho-eIF2alpha and total eIF2alpha of DYT1 and control mice obtained from postnatal day 14 in important brain regions thought to have a role in movement including the striatum, cortex, cerebellum, and midbrain. Completion of this study will further our understanding of where in the brain there is eIF2a pathway dysregulation early in neurodevelopment in DYT1 mice.

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**Student Authors (s):** Mikula, Olivia; UNC Charlotte

**Mentors (s):** Reitzel, Adam; UNC Charlotte

### **The expression, function, and evolution of Major Intrinsic Proteins in the phylum Cnidaria**

Aquaporins and aquaglyceroporins are Major Intrinsic Proteins (MIPs) that serve as channels that allow water and small molecules to travel across the cell membrane through selectively filters. This function is necessary for all organisms and MIPs are known to be shared in prokaryotes and eukaryotes. The MIP family has expanded tremendously in animals, but the function of these proteins remains little studied, particularly marine invertebrates. Eight MIPs have been previously identified within the model cnidarian, *Nematostella vectensis*. Cnidarians are a phylum of animals that are important for ecosystems and are informative for the evolution of gene families and protein function due to their phylogenetic position as an outgroup to vertebrates and insects. There are no reported data on the expression or potential function of MIPs in *Nematostella* or other cnidarians. I conducted database searches to collect similar proteins from diverse cnidarians. These proteins were used to create a phylogenetic tree that displays the evolutionary relationships between MIPs in the phylum Cnidaria. Furthermore, I am analyzing gene expression datasets to understand how MIPs are expressed during developmental stages and specific cell types. These data will be analyzed with protein models that together offer insight into the function of specific MIPs and can be compared to the phylogenetic tree to discern the evolution of function.

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**Student Authors (s):** Mayakis, Michelle; Kwon, Taeim; North Carolina State University

**Mentors (s):** Paciulli, Lisa; North Carolina State University

### **Exploring Mites on Lemurs**

Mites are small arthropods belonging to the class Arachnida. They are distantly related to spiders and scorpions. Mites can cause asymptomatic or symptomatic reactions in their hosts, with extreme cases causing and/or exacerbating disease. Nonetheless, there have been few studies on the relationship between mites and non-human primates (NHP), including lemurs. Therefore, in this study, captive lemur hair was examined for the presence of mites. The hypothesis was that some lemur species would have a higher density of mites than other species, and that the sex or age of lemurs would affect mite presence. The study was conducted under the Duke Lemur Center (DLC) Institutional Animal Care and Use Committee (IACUC) blanket protocol. Hair from six facial and eight limb regions of lemurs undergoing medical attention that differed by genus and species was examined under a compound light microscope. Fifteen lemurs from nine different species were sampled from varying sex and age classes. The results showed that there were no statistical associations between lemur sex or age and mite presence. Also, five lemurs had mites, and crowned lemurs (*Eulemur coronatus*) had more mites than the other species. It is unclear why crowned lemurs had more hair mites than the other species sampled. The information from this study will not only contribute to the lack of knowledge on non-human primate mites, but also provide insight into the relationship between mites and lemurs. Future research should include genetics to identify mite species, as well as the health of lemurs with mites. Funding generously provided by NC State's Department of Biological Sciences and Office of Undergraduate Research.

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**Student Authors (s): Mathew, Ashley; North Carolina State University**

**Mentors (s): Sikes, Michael; North Carolina State University**

### **The role of Upstream Stimulatory Factor in regulation of the cellular response to DNA damage**

Cancer is the second leading cause of death in the world and most commonly indicated by a loss-of-function mutation in the tumor suppressor, p53, the “guardian of the genome”. One in ten new cancer diagnoses present as lymphomas, which are largely induced by the overexpression of activation-induced cytidine deaminase (AID), a mutagenic enzyme used during B cell activation that induces double-stranded breaks (DSBs). When compounded, these mutations greatly increase the risk of lymphomagenesis. Preliminary data of the stress response transcription factor, upstream stimulatory factor (USF), has been shown to regulate the DNA damage response of lymphocyte precursor cells. Our research aims to identify a novel biochemical pathway relating USF expression to dysregulation of p53 and AID. To test this, B cell lines underwent RNAi to knockdown USF, a hypomorphic phenotype that is often found in cancer types where USF is expressed but unable to efficiently regulate gene transcription. RNA microarray analyses of knockdown lines showed that loss of USF dramatically alters the long-term transcriptional response to DNA damage, allowing for the potential accumulation of mutations. Data was subsequently validated via RT-qPCR and Western blotting, which demonstrated that knockdown of USF leads to repression of p53 and overexpression of AID. Though preliminary, these findings suggest a novel pre-cancerous marker for early detection and subsequent treatment of lymphoma.

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**Student Authors (s): Malone, Kai; North Carolina School of Science And Math**

**Mentors (s): Monahan, Kim; North Carolina School of Science And Math**

### **Production of Extracellular PET Hydrolase Using Transgenic Escherichia Coli to Degrade Polyethylene Terephthalate**

Polyethylene terephthalate (PET) is one of the most common industrially produced plastic polymers and is used in a variety of settings. It is most commonly used as a one-use plastic that is biologically robust enough to last over 500 years before breaking down. These plastics are polluting our ecosystems and infiltrating wildlife communities as microplastics. A novel bacteria *Ideonella Sakaiensis* was discovered to have the ability to break down this polymer as a source of energy and carbon using the PET hydrolase (PETase). Transferring the PETase gene into *E. Coli*, a more resistant bacterium, opens opportunities for application, however the necessary secretion pathways are not activated and the enzyme is only produced at an intracellular level. Modifying the PETase gene to facilitate protein secretion could prove to be an easily applicable and universal treatment for polyethylene pollution in both natural environments and landfills. N-terminus signal peptide tags have shown evidence to induce intracellular and extracellular protein transport. Therefore, by splicing a PhoE signal sequence onto the PETase vector before expressing the gene could produce a viable PET hydrolase enzyme. Plastic degrading properties will be quantified through a mass-loss determination assay as PET film is exposed to the treated *E. Coli* for 2 weeks and the total mass of PET is observed before and after treatment. Brefeldin A will be applied as a control as it inhibits protein transport in bacterial cells and will be a basis of comparison in protein secretion. This research could be extended as many other transport pathways are not applied which could be effective in this scenario as well as other host organisms.

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**Student Authors (s):** Malachowski, Taylor; East Carolina University

**Mentors (s):** Geyer, Chris; East Carolina University

**Retinoic acid regulates KIT protein expression in peritubular myoid cells in the mammalian testis**

Mammalian spermatogenesis (production of sperm) takes place in the testis within the germinal epithelia of the seminiferous tubules. Within these tubules, germ cells develop in intimate contact with two somatic cell types – within the epithelium are Sertoli cells, and surrounding the tubules are peritubular myoid cells (PTMs). PTMs are known to provide key paracrine signals for developing germ cells and are thought to contract their cytoskeleton to extrude newly-produced nonmotile testicular sperm from the testis. However, nearly nothing is known regarding how PTMs are instructed to regulate these distinct functions. Recent data from our lab may begin to shed light on these diverse processes – we made the exciting discovery that expression of an essential receptor tyrosine kinase (KIT receptor) is negatively regulated in PTMs by the diffusible morphogen retinoic acid (RA). RA provides a key signal promoting sperm release from the epithelium in a process termed ‘spermiation’. Since KIT receptor is a key initiator of kinase signaling pathways, we are working to define the underlying mechanisms by which RA regulates KIT to direct PTM function using a variety of in vivo and in vitro approaches using freshly-isolated PTM cultures. Results from this work will reveal the role of RA in ensuring proper PTM function to support spermatogenesis and male fertility.

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**Student Authors (s):** Lopez-Marin, Stefani; Acevedo, Jhon; Belmont Abbey College

**Mentors (s):** Polnaszek, Timothy; Belmont Abbey College

**Habituation of Madagascar Hissing Cockroaches**

Madagascar hissing cockroaches are a fascinating species that originates from the island of Madagascar. This insect does not look like the typical household cockroaches and it emits a special sound for intraspecific communication during social encounters and it is also used as a defense mechanism. This sound is produced from a pair of modified spiracles located on the segments of the abdomen. While observing the Madagascar hissing cockroaches, hissing was noticed when shelters were moved or when new food was being added, leading to the thought that all the subjects may hiss equally when disturbed. But a closer observation revealed that different individuals hissed more than others. Why might there be differences in hissing? One explanation is habituation. Research has suggested that insects can be “tamed” with frequent human contact. In this experiment, we studied whether an individual cockroach can acclimate to being handled and whether their housing environment has an effect on this process. These subjects were split into two different groups, one being in an enriched environment and the other being in a “non-ideal” environment to the needs of the roach. Over the course of four weeks, 12 subjects were handled by the same person. The “ideal environment” showed dramatically less hissing in comparison to the “non-ideal” group over time, showing an increased form of habituation. The “non-ideal” group initially hissed constantly, but a slow decrease in hissing showed a slower rate of habituation.

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**Student Authors (s):** Leimkuehler, Joli; Elizabeth City State University

**Mentors (s):** Young, Margaret; Elizabeth City State University

#### **Investigating Spontaneous Mutation for Salt Tolerance in *Kalanchoe diademata***

Mother of Thousands (*Kalanchoe diademata*), a succulent, develops hundreds of clonal plantlets within a month on the edges of the leaves. This makes it a promising plant to study spontaneous mutations in a lab setting. The objectives were to find mutants expressing genes that would allow them to survive high concentrations of salt. Plantlets were collected and placed in soil-less media under 16-photoperiod. The plantlets were treated with 0.5 M and 1 M NaCl solution twice a week, for 4 weeks. Controls were treated with water twice a week. Results showed that the controls rooted, appeared very healthy, with new green growth and plantlets on the edges of leaves. The treated plantlets rooted in the media and their leaves remained the same size, but turgid, and varied in color from yellow to dark purple. No treated plantlets have died. The plantlets will be observed to see if they produce new leaf growth after the initial shock of salt treatments; and also if any of them produce new clones.

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**Student Authors (s):** Kurzlechner, Leonie; Duke University

**Mentors (s):** Landstrom, Andrew; Duke University

#### **The cardiac electrophysiologic impact of pharmacological inhibition of the Na/K-ATPase pump**

The ATP1A3 gene encodes isoform 3 of the Na<sup>+</sup>/K<sup>+</sup>-ATPase pump responsible for maintaining resting membrane potentials of neurons and cardiac myocytes. Pump malfunction causing ATP1A3 pathologic variants have severe neurologic and cardiac impacts and are associated with alternating hemiplegia of childhood (AHC). Patients with AHC exhibit cardiac abnormalities, including shortened QTc, hypothesized to contribute to premature death. We hypothesized that Na<sup>+</sup>/K<sup>+</sup>-ATPase pharmacological inhibition leads to QT shortening and development of arrhythmia predisposition. Cardiac electrophysiology (EP) studies were performed on wildtype BL6J mice (n=7; female=3) using a comprehensive EP platform (iWorx Systems, Inc., LabScribe v4, NH, USA). ECG recordings were conducted by placement of six platinum subdermal leads. Baseline RR, PR, QRS, and QT intervals were measured. Corrected QT (QTc) was calculated using Bazett's equation. Mice received 5 ug/g digoxin or 10 ug/g ouabain administered intraperitoneally in two equal doses of 150  $\mu$ L. ECG parameters were re-measured 15 minutes after each dose. Cumulative 10 ug/g ouabain increased the RR, PR, QRS, and QTc by 89.6%, 41.4%, 134.0% and 59.9%, respectively. Cumulative 5 ug/g digoxin increased the RR, PR, QRS, and QTc by 4.6%, 19.9%, 80.4%, and 31.5%, respectively. Taken together, these results indicate that ouabain and digoxin slows atrioventricular conduction (increased PR), ventricular conduction (increased QRS), and prolongs repolarization (increased QT). No arrhythmias were spontaneously elicited. Our results do not support our hypothesis, as we did not see QTc shortening or arrhythmia generation. We conclude that murine models may not recapitulate the same clinical phenotype of patients with AHC-associated ATP1A3 variants.

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**Student Authors (s):** Krebs, Rose; North Carolina State University

**Mentors (s):** Laster, Scott; North Carolina State University

**Dose dependent inhibition of mast cell calcium signaling by fruit-derived polyphenol extracts in vitro**

Food allergies represent a major health issue worldwide. Mast cells drive the allergic response by producing pro-inflammatory compounds in the presence of an allergen with calcium ions acting as important secondary messengers in this process. This study investigates the ability of fruit-based polyphenols to inhibit calcium influx. We predicted that extracts from muscadine grapes, cranberries, or wild blueberries would inhibit calcium signaling in an in vitro model of mast cells. RBL-2H3 cells were stimulated with the calcium ionophore A23187 in the presence and absence of a series of wild blueberry, cranberry or muscadine grape extracts. Intracellular calcium levels were monitored by fluorescence spectroscopy and the change in fluorescence was calculated after stimulation. Treatment of RBL-2H3 cells with wild blueberry and muscadine grape extracts significantly reduced calcium influx in a dose dependent manner. In contrast, treatment with cranberry extracts did not produce a significant reduction in calcium signalling. Although preliminary, this data suggests that some fruit-based polyphenols may be capable of preventing mast cell activation. Future studies will investigate if these extracts can prevent degranulation of mast cells and investigate the impact of these extracts on primary mast cell calcium signaling.

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**Student Authors (s):** Joyce, John; North Carolina State University

**Mentors (s):** Chen, Stefanie; North Carolina State University

**The use of adaptive laboratory evolution and the MP6 mutagenesis system to generate E. coli capable of using ethylene glycol as a sole carbon source**

Adaptive laboratory evolution (ALE) uses natural variance and Darwinian-like selection to produce desired phenotypes; mutagenesis creates highly variant genetic populations. Together, these two methods can quickly and effectively generate organisms that meet the user's needs. Our future bioremediation project involving the degradation of polyethylene terephthalate (PET) requires E. coli that can metabolize ethylene glycol (EG), a byproduct of PET degradation. Using an in vivo mutagenesis system (MP6) which grants inducible, broad-spectrum mutations, in conjunction with ALE, we sought to generate an E. coli strain capable of using EG as a sole carbon source. We were unable to generate EG utilizing mutants directly from the wild-type strain. A steppingstone method previously employed in similar contexts was used to first evolve a strain able to use 1,2-propanediol (PPD), a similar substrate to EG. The EG using mutant was then derived from the PPD mutant. Full-genome sequencing of the EG mutant revealed 418 mutations had occurred. The transposition of an insertion sequence (IS5) between the fucPIC and fucAO operons which is known to be necessary for EG metabolism was observed, but there were no additional mutations in this essential region. Several mutations in other genes associated with the EG phenotype may be linked to the conventional EG metabolic pathway. Although results of this study show that the MP6 system likely assisted in the generation of the EG mutant, the vast quantity of potentially undesired mutations that accumulated may seem to contraindicate the use of the MP6 system and favor a lower mutagenic approach.

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**Student Authors (s):** Joshi, Anusha; North Carolina Central University

**Mentors (s):** Lopez, Dayami; North Carolina Central University

**Effects of increasing T3 concentrations on APOH/A1AT in C3A cells**

The thyroid gland produces a type of thyroid hormone called Triiodothyronine (T3). It is secreted into the bloodstream to control body metabolic rate, bone maintenance, and brain development. The thyroid hormone reduces the amount of PCSK9, an enzyme that acts as a key player in plasma cholesterol metabolism. It has been shown to regulate the levels of low-density lipoproteins (LDLs), which removes the excess cholesterol from the bloodstream. Hypothyroidism increases plasma LDL levels and requires thyroid hormone treatment to lower LDL levels again effectively. The release of T3 lowers the PCSK9 and LDL-cholesterol levels. The purpose of my experiment was to test the effects of increasing T3 concentrations on apolipoprotein A (APOH) and alpha-1 anti-trypsin (A1AT), two potential inhibitors of PCSK9 function, in human hepatocyte-like C3A cells.

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**Student Authors (s):** Ishman, Enosh; UNC Charlotte

**Mentors (s):** Steck, Todd; UNC Charlotte

**Identifying Collateral Sensitivity Networks and Associated Genetic Markers in Burkholderia Species**

Antibiotic collateral sensitivity, seen when a drug-resistant organism becomes sensitive to an alternate drug, might be used to develop therapies to treat chronic bacterial lung infections in cystic fibrosis patients. Our purpose is to characterize how common this phenomenon is and to identify genes or specific mutations involved in collateral sensitivity (CS) in the study organism *Burkholderia multivorans*. Methods involve each strain being swabbed onto growth agar to create a lawn of bacteria, then adding antibiotic disks to the center of the Petri plate. After incubation to promote bacterial growth, the killing area caused by antibiotic diffusing from the disk is measured. This zone reflects the resistance category of the plated bacteria. Resistant bacteria are then tested for collateral sensitivity. If tested positive, an Etest, a strip of paper containing a known gradient of antibiotic concentration, will be used to quantitate the degree of change in antibiotic resistance. The Etest strip is placed on a plate seeded with bacteria, which then grows up to the place on the strip corresponding to the killing of antibiotic concentration. This process of selecting for resistant mutants, and identifying those that exhibit CS, will continue for multiple generations. The ultimate goal is to identify mutations involved in CS, and confirm involvement of those genes by introducing that mutation into a wild type strain using gene editing techniques.

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**Student Authors (s):** Houser, Shannon; Duke University

**Mentors (s):** Sanders, Laurie; Duke University

**The role of LRRK2 in cell cycle regulation and DNA damage response**

Parkinson's disease (PD) is the most common neurodegenerative movement disorder and is characterized by the death of dopaminergic neurons. It is known that the G2019S mutated variant of the leucine-rich repeat kinase 2 (LRRK2) gene increases both the kinase activity of the LRRK2 protein and the risk of PD; however, the function of the LRRK2 protein remains relatively unknown outside of this kinase activity. There is evidence that LRRK2 knock out models show levels of mitochondrial and nuclear DNA damage that is not seen when the gene is present. We seek to elucidate the effects of the absence of LRRK2 and the subsequent DNA damage on cell activity, cell survival, and levels of cell cycle regulatory proteins. We hypothesize that knocking out LRRK2 from the genome will increase the cell's susceptibility to DNA damage when compared to wild type control. The data found may suggest that a response to DNA damage is responsible for the loss of dopaminergic neurons in the most prominent genetic predisposition to PD. The data will give us a better understanding of the cell pathways involving LRRK2 and illuminate a function of the protein previously unexplored. Understanding LRRK2's part in DNA viability and the cell cycle regulatory pathway can help us better understand the functional role of LRRK2 and how the upregulation in kinase activity of the G2019S mutation increases the risk of PD.

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**Student Authors (s):** Holden, Hanna; Nellom, Dy'monique; Michalski, Mark; Elizabeth City State University

**Mentors (s):** Young, Margaret; Elizabeth City State University

**Ethyl Methanesulfonate (EMS) Mutagenesis of Wisconsin Fast Plants (*Brassica rapa*) for Salinity Tolerance**

Wisconsin Fast Plants (WFP; *Brassica rapa*) is a model plant that has been used for experiments in laboratories due to its fast generation rate, high survivability, and petite size. With the exception of Halophytes, plants are not salt tolerant because the salt prevents the absorption of nutrients which usually results in death. Experiments were conducted using 0.2% ethyl methanesulfonate (EMS) to induce mutation for salt tolerance in WFP. Generations M0-M2 were not subjected to NaCl and were observed for any changes in the phenotype. In the M3 generation, seeds were germinated, then watered with 250 mM NaCl once weekly for 5 weeks. The results showed that the plants treated with EMS survived the salt treatments, but the seeds produced were small and misshapen. No control plants survived or produced seeds after the salt treatments. Further experimentation will be done to see if the M4 seeds of Wisconsin Fast Plants (*Brassica rapa*) are tolerant to salt.

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**Student Authors (s):** Hinton, Tara; North Carolina School of Science And Math

**Mentors (s):** Goforth, Kayla; UNC Chapel Hill

#### **Using conditioned site fidelity to explore the precision of the sea turtle magnetic sense**

Foraging site fidelity is a phenomenon whereby animals repeatedly return to the same foraging ground, even after undergoing lengthy migrations. Site fidelity is particularly well-documented in almost all species of sea turtles, and occurs in various locations across the globe. Yet despite the extensive literature on site fidelity, little is known about the mechanisms underlying its development. Because sea turtles are known to detect and use two components of Earth's magnetic field for navigation, this 'magnetic GPS' likely plays a critical role in the formation of site fidelity. Previous research has shown that sea turtles can learn to associate a specific magnetic field with food; turtles conditioned to a specific magnetic field exhibit increased feeding behavior when exposed to the conditioned field. However, what still remains unknown is the degree of specificity with which sea turtles can learn magnetic field information, and thus, foraging locations. In order to investigate the sensitivity of turtles' magnetic sense, we conditioned sea turtles to a magnetic field and then exposed the turtles to a variety of novel magnetic fields that were magnetically similar to, and geographically near, their conditioned field. Analyses are still in progress, but we expect that sea turtles will only display feeding responses in their conditioned magnetic field, and not in novel magnetic fields. Understanding the precision with which sea turtles can learn and differentiate magnetic fields will provide new insight into both the magnetic sense and foraging site fidelity of sea turtles.

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**Student Authors (s):** Hanis, Malone; North Carolina State University

**Mentors (s):** Simpson, Melanie; North Carolina State University

#### **Characterizing a Biological Marker for Castration Resistant Prostate Cancer**

In 2020 the American Cancer Society expects 191,930 new cases of prostate cancer leading to 33,330 deaths. A common treatment for advanced prostate cancer is termed chemical castration, and involves using anti-androgen treatment to block the activity of androgen hormones and reduce the tumor size. Most patients will develop castration resistant prostate cancer, which is lethal and results in a horrible quality of life. Our lab is working to find a biological marker in men that will indicate a higher probability of developing castration resistant prostate cancer, and potentially improve current treatments. In this project, we are focused on the enzyme UGDH, which controls androgen sensitivity in prostate cells and is a biomarker for castration resistance. We have measured the proliferation of prostate cancer cell lines to examine the link between the expression of UGDH and the cell's response to anti-androgen treatment. Enzalutamide is an anti-androgen that is already used clinically and is applied to the prostate cancer cells to test the cell lines response to anti-androgens. Our results show that reducing expression of UGDH in LNCaP 81, a cell line that mimics the castration resistant condition, restores the sensitivity of these cells to enzalutamide inhibition of growth. This is a promising result because the inhibition of UGDH may be possible to combine with enzalutamide treatment in patients. In the future we plan to investigate the effect of 4-MU, which is a chemical scavenger of the UGDH product approved for clinical use in other diseases.

**Student Authors (s):** Giap, Giang; Dheyaa, Maryam; Bui, Khoi; Wake Technical Community College

**Mentors (s):** Fadri, Maria; Wake Tech Community College

### **Presence of Airborne Microorganisms in Urban Environments**

The relationship between urbanization and microorganism diversity is determined by sampling the air of buildings at differing times of foot-traffic and culturing any microorganisms caught. The prevalence of pathogenic microbes in the air was hypothesized to be proportional to the presence of people. The bacterias that were sampled included non-hemolytic and hemolytic bacteria, as some were only able to grow in blood agar. Two of the five bacterias were determined to be *Staphylococcus epidermidis* through DNA sequencing. As a bacterium of human skin and mucous membrane, *Staphylococcus epidermidis* can be transmitted through close contact and also has the ability to be airborne due to its small size. The presence of the bacterium at differing times of foot-traffic does not support the hypothesis. *Staphylococcus epidermidis* has been found to be the cause of nosocomial infection, but further research would be required to identify any pathogenic abilities with this specific strain.

**Student Authors (s):** Ghotkar, Rohit; North Carolina State University

**Mentors (s):** Marsden, Kurt; North Carolina State University

### **Identifying the Molecular Interactions of Cyfip2 Necessary to Regulate the Startle Response**

Animals must be able to filter out extraneous environmental stimuli while responding to important ones in order to survive. The acoustic startle threshold (AST) is a sensory filter that allows animals to distinguish between innocuous and dangerous sounds. The importance of this threshold is highlighted by the fact that dysregulation of the AST is associated with mental health disorders including anxiety, schizophrenia, and autism spectrum disorder (ASD). But the genes that establish and maintain the AST are mostly unknown, and so to identify genetic factors that regulate the startle threshold, we conducted a forward genetic screen and found mutants with a reduced AST that had a nonsense mutation in the gene encoding cyfip2 (Cytoplasmic Fragile X Mental Retardation Protein (FMRP) Interacting Protein 2). Re-expressing cyfip2 in mutants with a heat shock promoter-driven transgene rescues the AST, verifying that loss of cyfip2 causes hypersensitivity. Cyfip2 regulates actin polymerization through its interaction with Rac1 and may influence mRNA translation by interacting with FMRP. To identify which of these the molecular interactions is necessary for cyfip2 to regulate the AST, we induced missense mutations in the Rac1 and FMRP interacting domains, and re-expressed GFP-tagged versions of these transgenes in cyfip2 mutants. Currently, I am using image analysis to quantify the levels of heat shock-induced expression for each of these cyfip2 constructs to determine which molecular interactions are necessary to regulate the AST. Identifying the molecular interactions that cyfip2 uses to regulate the AST may provide new therapeutic targets for anxiety, schizophrenia, and autism.

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**Student Authors (s):** Flowers, Laura; Nellom, Dy'monique; Payne, Gloria; T. Ascencio-Ibanez, Jose  
Elizabeth City State University; North Carolina State University

**Mentors (s):** Young, Margaret; Elizabeth City State University

**Regeneration of Florida Lanai (*Solanum lycopersicum*), a candidate tomato cultivar for studying  
geminiviruses in plants**

Tomato (*Solanum lycopersicum*) is ranked as the second highest horticultural crop in production. Tomato has important characteristics such as a small genome and easy transformability, making it a great candidate as a model system for fruits. The current tomato model plant is the cultivar Micro-Tom, but Micro-Tom has a mutant genetic background (induced recessive genes). This makes it an unlikely candidate to study geminiviruses, due to its inability to express these genes effectively. Florida Lanai, another tomato cultivar is a better system because of its small genome, low maintenance, and its ability to respond independently to different geminiviruses. The goal of this experiment was to develop a plant regeneration protocol from leaf explants of Florida Lanai. This is one of the first steps in developing it as a model system. Florida Lanai seeds were surface sterilized and germinated on a hormone free MS medium. Four-week-old in vitro leaves were cut from these seedlings and transferred to shoot induction medium (MS supplemented with different hormones). As early as 2 weeks after culture, meristemoids were observed. Using this protocol, over 85% of the leaf explants survived on the shoot induction media. After 6 weeks, shoots were produced from the leaf explants. These shoots were rooted on hormone free MS medium. Rooted plants were acclimatized in soil-less medium. In the future, these in vitro grown plants will be compared with those from seeds for any genetic variation.

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**Student Authors (s):** Edwards, Ashley; UNC Pembroke

**Mentors (s):** Alexander, Courtney; UNC Pembroke

**Research Suggests Local Plant Extracts Influence hsp-70 & Apoptosis in *C. elegans***

Cancer cells can undergo proliferation without interference from apoptosis as a result of mutations in the cells. *C. elegans* are a model organism to study cancer pathways, tumorigenesis, and apoptosis. These nematodes have many conserved genes and pathways, and their transparency allows cells to be monitored directly. Via heat shock (HS) we can simulate illness in *C. elegans*, and then treat them afterwards with plant extracts local to North Carolina. We plan to monitor the levels of hsp-70 and bcl-2 using a western blot. We must first determine how the plant extracts influence these protein levels before we use mutant strains to discover the affect on apoptosis. BS3164 and GC565 are temperature sensitive *C. elegans* strains that cause tumorigenesis in the germline. Prior to running the experiment, the nematodes will be age-synchronized and FUdR will be kept on the plates to prevent untreated *C. elegans* eggs from hatching after they are expelled from the vulva of treated *C. elegans*. Before dividing the worms into treatment and control groups, they will undergo HS. Every 1-3 days, the plates will be examined to score deceased nematodes. One, five, seven, and ten days following exposure to the plant extract, a western blot will be performed to measure protein levels. Our goal is to determine which plant extract significantly increases apoptosis as a potential drug to treat cancer.

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**Student Authors (s):** Droste, Emma; North Carolina State University

**Mentors (s):** Mowat, Freya;

### **Retinopathy in the Red Wolf; Retinal Histology Analysis and Genetic Mapping of the X Chromosome**

Retinopathy is a collection of retinal disorders and diseases that is affecting the highly inbred and endangered population of red wolves (*Canis rufus*) in the Southeastern United States. The retina in blind red wolves is thinner than in unaffected wolves, so we believed there would be a measurable decrease in certain locations and layers within the retina. Because retinal function is highly regulated genetically and the red wolves presenting the disease are all related, it is believed that the condition is genetic. Therefore, both histological and genetic techniques were used to study the wolf population. Histology from unaffected wolves (n=2) and affected wolves (n=3) were imaged and analyzed in ImageJ to assess thickness of the retinal layers. Whole genome sequencing from eight wolves were also curated to find areas of significance along the X-chromosome based on expected inheritance patterns. Histology results showed affected wolves have decreases in the central superior retina, or area centralis, of the red wolf outer retina. Genetic analysis results showed a region between 6.85-8.15 Mbps on the X-chromosome that is related to this retinopathy. These genetic studies, combined with the histological results, could be used to search for genes significant to outer retinal degeneration within the X-chromosomal region found to aid the development of a genetic test to prevent further proliferation of this condition in the red wolf population. Determining the phenotypic and genotypic presentation of this retinopathy will aid further diagnosis of the disease in the population and also assist treatment of this condition.

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**Student Authors (s):** Dombaxe, Catia; Methodist University

**Mentors (s):** Vecellio, Mark; Methodist University

### **Detection of Latent Bloodstains Covered with Three Types of Current Top-Selling Paint/Primer Mixtures**

Research has previously established the effectiveness of Luminol in detecting latent blood that had been painted over, Bluestar™ is less studied. This study aids in elucidating some of the previous research findings. Much of the previous study did not involve paint/primer combination mixtures, which is a very strong chemical in paints, which should make a harder task to detect the bloodstains under this condition. However, Bluestar™ has been given wonderful results. The focus of this study is to provide tangible results that relate to three of the top-selling paint/primer mixtures sold by Walmart. In addition, the uniqueness of this research lies on the fact that even at seven layers, the detection of blood is still able to be detected and photographed. Approximately .05 mL of undiluted human blood was projected onto an 1/2" drywall samples and allowed to air dry for a minimum of 24 hours. Four drywall samples were each painted with between one and seven layers of three of the most commonly sold paints plus primer within the United States. Bluestar™ was then applied to the samples in an effort to determine if chemiluminescence could be observed, thus providing a presumptive identification of blood. Results were photographed using a Nikon camera. Chemiluminescence was observed upon application of Bluestar™ in all of the drywall samples except one: six layers of Antique White Colorplace. The intensity of the chemiluminescence was rated as medium or high in all samples with three or fewer coats of the paints. A gradual decrease in intensity was observed between four and seven coats of each of the paints.

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**Student Authors (s):** Dave, Parth; East Carolina University

**Mentors (s):** Horn, Patrick; East Carolina University

**Investigation of conserved cysteines on fatty acid desaturase function**

Plants are an incredibly diverse group of organisms with over 300,000 species inhabiting different environments worldwide. Recent advances in biotechnology have driven investigations into the biochemical properties of plant systems to improve agricultural production in dynamic environments. The goal of my project is to test the effect of selected amino acid mutations on the FAD2 enzyme from *Arabidopsis thaliana*, a model system for plants and seed oil production. FAD2, a delta 12 fatty acid desaturase (FAD), is an essential plant enzyme that introduces a double bond at the 12th position from the carboxyl end of an 18:1 fatty acid. We have identified six different cysteine residues within the peptide sequence of FAD2 that are well conserved in planta, suggesting that they are essential to the functionality of the enzyme. Cysteine residues are often involved in catalysis and stabilizing the tertiary structure of proteins through disulfide bond formation. Each of these cysteine residues has been substituted for the amino acid alanine which cannot form disulfide bonds (with cysteine-to-serine planned as well) and/or render it incapable of carrying out catalysis. I hypothesize that each mutation will result in a FAD2 enzyme with reduced activity, likely due to decreased stability. Initially I will test these mutants in yeast cells given their eukaryotic properties and efficiency in producing the recombinant enzyme, as verified by previous research. Yeast cells also replicate rapidly, thus the effects of the mutations can be observed in far less time. Ultimately, the FAD2 site-directed mutants will be tested in *Arabidopsis* to ultimately gain additional insights into plant oil production.

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**Student Authors (s):** Catacalos, Cassandra; UNC Charlotte

**Mentors (s):** Chakrabarti, Kausik; UNC Charlotte

**Conservation in the 5'UTR of SARS-CoV-2 shows promising potential for developing RNA decoy therapeutics**

The urgency of investigating SARS-CoV-2 has grown since the declaration of pandemic occurred in early 2020. Understanding how the SARS-CoV-2 virus hijacks the machinery of human cells to perpetuate itself, particularly the recognition mechanism of this RNA virus that allows it to utilize human (host) proteins for viral replication, is key to developing an effective therapeutic. Previous studies have shown conclusive evidence that the 5' end of the viral RNA genome (5' UTR) is critical to drive viral replication processes, however the network of human proteins that enable 5'UTR binding to trigger viral replication and its underlying mechanisms remain unknown. Therefore, we took a novel approach to (1) first computationally determine the most conserved 5' UTR RNA structure of SARS-CoV-2 genome and its potential binding sites for human proteins and (2) design and develop synthetic 'RNA decoys', mimicking conserved 5'UTR structure that can entrap proteins responsible for viral replication to counteract SARS-CoV-2 infection. To this end, we targeted and investigated the 5'-UTR RNA of SARS-CoV-2 using the Wuhan original sequence and analyzed it in comparison to 20 SARS-CoV-2 strains using comparative genomics and RNA folding algorithms. Using large databases of experimentally derived RNA binding motifs, we were able to accurately predict and map the binding sites of human proteins to SARS-CoV-2 5' UTR. This new data provides a framework for experimental validation of the viral RNA and host protein interactions, which will allow us to test effective RNA decoys to block SARS CoV-2 infection in cells and experimental animal models.

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**Student Authors (s):** Bush, Brianna; UNC Charlotte

**Mentors (s):** Yan, Shan; UNC Charlotte

### **Function and mechanisms of APOBEC3 in genome integrity and cancer biology**

The genome of cells is exposed to damage regularly from endogenous resources such as oxidative stress or environmental toxins, leading to DNA lesions. Cells have evolved several stress response pathways such as DNA repair and DNA damage response pathways to maintain genome integrity. Defects in DNA repair and DDR pathways have been linked to human diseases including cancer. The APOBEC3 family of cytosine deaminases can turn cytosine bases into uracil bases, leading in C to T transitions/mutations and DNA strand breaks. Increased APOBEC3 expression and enzymatic activities in certain types of cancer cells are consistent with detected mutational signatures, suggesting APOBEC3 is involved in cancer etiology or oncogenesis. This review will examine the diversity of functional domains in seven APOBEC3 genes (A3A-A3G) and the evolution of APOBEC 3 genes in mammals and their survival advantages. Whereas APOBEC3 proteins are antiviral factors that are developed to protect humans and mammals from viruses, we will focus on how DNA lesions induced by APOBEC3 are repaired and their effects on genome stability. We intend to provide evidence and analysis of how APOBEC3 may contribute to cancer development and other diseases such as HPV, HIV, and cancer. Insights from this review can help researchers develop drugs that can restrict or modulate APOBEC proteins and/or associated cytosine deaminase activity for new avenues to cancer therapeutics.

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**Student Authors (s):** Britt, John; North Carolina State University

**Mentors (s):** Scott, Max; North Carolina State University

### **Testing the Specificity of a New Promoter, 303I, in *Lucilia sericata***

In past studies, it has been shown that larvae of the green bottle fly, *Lucilia sericata*, can be engineered to express human platelet-derived growth factors (PDGF), with great potential to be used in wound therapy, is both cost-effective and a possible treatment for MRSA infections (Linger et al., 2016). A goal of this project is to increase the specificity of transgene expression to the salivary glands allowing the expressed protein, such as PDGF, to enter the wound. To test a new salivary specific promoter 303I, *L. sericata* embryos were injected with a piggyBac plasmid containing a predicted salivary gland promoter driving a tetracycline transactivator (tTA) and marked with a green fluorescent marker and a piggyBac helper plasmid. Injected G0 flies were crossed with wild-type flies and G1 offspring were selected if GFP was expressed, indicating a transgenic fly. Heterozygous and homozygous lines were created by continued crossings. Heterozygous flies were then crossed with pB20 flies, which have a red fluorescent protein (RFP) upstream of a tet operator. The offspring of this cross showed high expression of GFP in the salivary glands along with RFP expression after dissection, indicating that tTA was being expressed in the salivary glands. RFP was not seen in the dissected fat body or gut. Dissected control flies show lower GFP expression and no RFP expression in the salivary glands. This indicates that the new promoter is specific to the salivary glands of the maggot and can potentially be used to make transgenic maggots for wound therapy.

**Student Authors (s):** Briggs, Emma; North Carolina State University

**Mentors (s):** Youngsteadt, Elsa; North Carolina State University

### **Efficacy of Pan Traps in Estimating Wild Bee Abundance**

Wild bees are essential pollinators in many natural and agricultural systems. However, wild bees and other pollinators are currently experiencing an unprecedented population decline. Researchers commonly rely on passive sampling methods such as pan traps to monitor pollinator populations, but the effectiveness of these methods has never been directly validated by a reliable survey method. To test the efficacy of pan traps, we conducted a mark-recapture study and deployed pan traps at three sites in the Butner-Falls of Neuse Game Lands in summer of 2020. We hypothesized that pan trap capture rates would not provide an accurate estimate of bee population size. To estimate absolute population sizes of bees at three sites, I conducted mark-recapture surveys for four taxa: carpenter bees (*Xylocopa virginica*), green sweat bees (*Augochlorella* sp., *Augochlora pura*, and *Augochloropsis* sp.), long-horn bees (*Melissodes bimaculatus*), and leafcutter bees (*Megachile* sp.). I repeated the surveys for five total weeks, then compared the resulting population estimates to pan trap and aerial netting data collected at the same sites in alternate weeks by the NC Wildlife Resources Commission. Although data analysis is ongoing, preliminary results support our prediction that pan traps are highly biased and do not reflect absolute population sizes of the bees in this study. This study is the first to attempt a direct comparison of common pollinator monitoring techniques with absolute population estimates generated from mark-recapture surveys. Our results indicate that more research is required to validate common monitoring protocols for these critically important but threatened pollinator species.

**Student Authors (s):** Augoustides, Victoria; North Carolina State University

**Mentors (s):** Kolar, Praveen; North Carolina State University

### **A North Carolina solution to economic Swine Waste-Water Treatment: Co-synthesis of glucose and biochar from biomass of *Pinus taeda* (Loblolly pine)**

In North Carolina, there is a significant interest in creating a circular bioeconomy and the area of focus in this research is the intersection of the pine and swine industries. The cultivation of swine leads to wastewater that is teeming with environmentally toxic substances and reduction of the cost of purification of this wastewater is of research interest in the BAE department. Using biochar sourced from lignocellulosic biomass and chemically-treated to remove those toxic substances could be a promising solution for this issue given that it is cost effective; has potential to reduce the environmental impacts of swine production; and is an inherently sustainable material. This project inquires if a bioprocess involving the isolation of the lignocellulosic carbohydrates from Loblolly pine biomass and subsequent co-production of glucose and biochar is feasible. Adding in the production of monosaccharide precursors for other bioprocessing applications enables the producer of the biochar to then sell the coproduct and use the revenue to continue producing biochar. The present data reflects valuable baseline characterization data related to physical and chemical properties of raw Loblolly pine wood including BET specific surface area, acid value, the point of zero charge, cation exchange capacity, elemental analysis, Time-of-Flight Secondary Ion Mass Spectrometric Analysis X-Ray Photoelectron Spectroscopic Analysis, Boehm Titration and Scanning Electron Microscope-Energy Dispersive Spectroscopic Analysis. From this data, the experiments will continue in investigating the potential of this bioprocess and the feasibility of scaling it up.

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**Student Authors (s):** Kluge, Madison; Lynch, Arilyn; Rodriguez, Matthew; Catawba College

**Mentors (s):** Bolin, Jay; Catawba College

**Measuring the decline of Green Ash (*Fraxinus pennsylvanica*) dominated Piedmont Swamp Forest due to the initial impacts of the Emerald Ash Borer (*Agilus planipennis*) in Rowan County, NC**

The Emerald Ash Borer (EAB) is a relatively new invasive species to the central piedmont of North Carolina. Our goal is to measure the decline and the patterns of change in a Green Ash dominated swamp forest in the Catawba College's Fred Stanback Jr. Ecological Preserve. In fall 2019 we established six, 200 m<sup>2</sup> plots using a nested plot design to measure changes in canopy, sapling-shrubs, and herbaceous vegetation. We resampled the plots in fall 2020. Our canopy data indicated a relatively low diversity in the tree canopy, trees importance values in descending order (of the top 5), green ash (*Fraxinus pennsylvanica*), sweet gum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), black willow (*Salix nigra*), and American elm (*Ulmus americana*). The canopy was dominated by green ash, accounting for 68% of trees greater than 10 cm dbh. In fall 2019, 20% of green ash trees were visibly infected with signs of EAB: "D" shaped EAB exit holes in the bark, larval galleries under the bark, and/or adventitious bark sprouts. Green ash infection and mortality data from our fall 2020 sampling will be highlighted.

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**Student Authors (s):** Ghosh Dastidar, Prabuddha; North Carolina School of Science And Math

**Mentors (s):** Chakrabarti, Kausik; UNC Charlotte

**A Potential Pancreatic Cancer Treatment in Pre-mRNA Splicing Inhibition: An Innovative Approach by Identifying Vulnerabilities in Pancreatic Cancer Cells Using Biflavonoid Isoginkgetin and Pladienolide B**

This research project identifies previously unknown vulnerabilities in pancreatic cancer cells that can be used to target cancer treatment. This research manipulates a step in the central dogma process (the biological process by which genes are expressed to synthesize proteins). The function of an essential protein (spliceosome) is inhibited by treatment by splicing inhibitors biflavonoid-isoginkgetin and pladienolide-B. This causes pancreatic cancer cells to express versions of genes (isoforms) that weaken the cells by inhibiting splicing (an essential process that aids in the synthesis of final mRNA). These newly discovered weaknesses, cancer-specific differential isoform expressions, are places to target for treatment. Splicing was inhibited using two inhibitors: pladienolide-B and biflavonoid-isoginkgetin. Three concentrations of each inhibitor were applied on four different cell types: aggressive and less aggressive pancreatic cancer cells (test), and healthy pancreatic and kidney cells (control and general control). The expression of eight different genes and their isoforms were tested using reverse transcription polymerase chain reaction. This resulted in 256 isoform expression data points. Additionally, the levels of the DBR1 protein (clean-up protein in the splicing process) were tested in all four cell types using Western Blotting. This experiment discovered five previously unknown vulnerabilities in pancreatic cancer cells. These weaknesses and missing defense mechanisms are targets for future treatment research. They were identified through differential isoform expression and DBR1 protein expression in cancer cells compared to healthy cells. Future research will utilize AI to expand the search of vulnerabilities into several thousand genes.

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**Student Authors (s): Wynne, Summer; Scarlett, David; Saliim, Eric; Bradley, Tanina;**

**North Carolina Central University**

**Mentors (s): Silver-Key, Catherine; North Carolina Central University**

#### **Engineering Design to Improve Ethanol Behavior Assay of DaBuGs**

Alcohol use disorder (AUD) is known to be attributed to genetic and environmental factors. The genetic predispositions are widely researched. *Drosophila melanogaster* is a suitable model organism for such research due to its genetic homology with humans. In an attempt to pinpoint genes that are related to an increased tolerance of ethanol, the Ethanol Mobility Behavioral Assay (EMBA) is conducted. For this assay a strain of *D. melanogaster* is selected from the *Drosophila* Genetic Reference Panel (DGRP). The flies are put into four vials, 8-10 per vial. One vial contains a wild-type strain and the other three vials contain flies of the selected strain. The flies are exposed to 100% ethanol (EtOH), timed and monitored for intoxication. The EMBA requires the vials to be tapped on a padded surface at sixty second intervals throughout the assay which averages 50-90 minutes. This assay is vulnerable to errors such as insufficient tapping and timing of taps. With an interdisciplinary correlation between the Biology and Physics departments and the FabLab we designed and engineered an apparatus that would allow the EMBA to be performed with less fallacies. In utilizing the design process, we developed a prototype to hold the four vials. Using an Arduino board, we developed and coded a circuit intended to move the device every sixty seconds. Through trial and error, we found aspects of the design that will need to be adjusted. When the design is finalized and in proper working condition the EMBA can be conducted more consistently.

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**Student Authors (s): Emerson, David; Harpe, Johnathan; Okafor, Ikenna;**

**North Carolina Central University**

**Mentors (s): Silver-Key, Catherine; North Carolina Central University**

#### **DaBuGs and Fab Lab Research and Design Collaboration**

The *Drosophila* Behavioural Genetics (DaBuGs) focuses on collecting data to perform a Genome-wide Association Study (GWAS) in order to discover genes that contribute to certain ethanol-induced behavioral phenotypes. To expedite the research, students design behavioral apparatuses using TinkerCAD and fabrication in a make-it space. During this semester students have investigated the response of a number of flies with genetic differences using the *Drosophila* Genetics Reference Panel (DGRP) and will present data graphs that will highlight any alcohol-resistance behavior characteristic of Alcohol Use Disorders (AUD). Additionally, the co-authors will showcase behavior-measuring devices that they have designed and/or fabricated. From our assays we are able to observe whether or not the ethanol-induced behavior of *Drosophila* strains DGRP-358, DGRP-399, DGRP-732, and DGRP- 782 have a greater resistance to alcohol compared to the w1118 (control) strain. While performing the assays students looked at ways to better perform the assays as well as ways to observe the flies. The designs include a way to observe and video record the *Drosophila* inside test tubes, a glass cage with four individual chambers for housing the flies in assays, and a semi-permeable chamber that will allow for better observation. All three 3D designs will be showcased in the presentation.

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**Student Authors (s):** Su, Lily; North Carolina School of Science And Math

**Mentors (s):** Langerhans, Brian; North Carolina State University

### **Evolution of Mechanical Isolation During Speciation in the Post-Pleistocene Radiation of Bahamas**

#### **Mosquitofish**

This study tests the role of ecology in the evolution of mechanical-isolating barriers in the process of speciation. We investigate lab-raised fish derived from the Bahamas mosquitofish populations on Andros Island in the Bahamas from eight blue holes: four high-predation regime blue holes and four low-predation regime blue holes. Due to the predation regimes, the fish have divergent phenotypic adaptations to living in or not in the presence of predatory fish. Our research studies the effects of the reproductive phenotypic adaptations, on the inter-population mating of Bahamas mosquitofish. We predict that mating with females from other blue hole populations will cause male gonopodial tip injury, especially in inter-predation regime (PR) mating. We also predict that genital injuries are related to hybridization probability, where injuries may indicate higher hybridization success or lower hybridization success, and that elongated, bony gonopodial tips will result in higher hybridization success than round, fleshy ones. We photographed the tips of their gonopodia and digitally landmarked them using TPS software after their mating attempt and recorded notes on post-mating injuries. We found that mating with foreign females can lead to injuries in the soft tissue and bones of the gonopodial distal tip, and injuries were more prevalent in inter-PR mating than in intra-PR mating. The gonopodial bone injuries could be associated with higher hybridization probability in inter-PR mating, but in intra-PR mating, bone injuries implicated a lower hybridization probability. The preliminary results supported our hypotheses, and helped shed light on the effects of mechanical isolation on speciation.

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**Student Authors (s):** Roozbehi, Tina; East Carolina University

**Mentors (s):** Horn, Patrick; East Carolina University

### **Determining the Lipid Composition in Transgenic Plants Susceptible to Oxidative Stress**

The objective of this project is to understand how redox processes affect photosynthetic membrane biology. Plants use electrons during photosynthesis to convert solar energy into chemical energy necessary for growth and survival. This includes directing the flow of electrons (i.e. redox) and their utilization as a source of energy. This research will incorporate genetic and lipid analysis approaches using *Arabidopsis thaliana* as the primary model system. *Arabidopsis* has a short 6 week life cycle and a large number of mutants and genomic resources making them ideal for study. A series of ~30 *Arabidopsis* mutants that affect broad chloroplast redox processes/states has been used as the source material. Our lab has genotyped each of these plants identifying transgenic plants. Using gas chromatography, we have determined the fatty acid composition from developing and mature leaves revealing lipid differences under normal conditions. In the future we will determine a more detailed lipid composition for different types of membrane lipids (e.g. monogalactosyldiacylglycerol or MGDG) at different developmental stages and characterize these mutants under different abiotic stresses. Ultimately these findings will inform our metabolic engineering strategies in high-value crop systems.

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**Student Authors (s):** Moses, Renyta; North Carolina State University

**Mentors (s):** Reiskind, Michael; North Carolina State University

### **Insights into the relationships between mosquito blood hosts, larval habitats, and morphology**

Whether adult female mosquitoes are host specialists and seek out a particular host or generalists and feed on any hosts in a given area is paramount for understanding how pathogens are transmitted in sylvatic and urban ecosystems. Studies have observed the influence of body size on blood hosts: a larger body size increases the likelihood of feeding on larger blood hosts and vice versa. Larval nutrition, cannibalism, and intraguild competition influence adult female mosquito body size. Which in turn impacts mosquito fecundity and fitness, i.e., a smaller mosquito produces fewer eggs and has increased mortality risk prior to ovipositioning. We investigate the relationships between adult body size, host utilization, intraguild predation, and larval habitat to determine whether the mosquito larval stage impacts blood host preference for adult female mosquitoes. To test these questions, we developed a comprehensive database comprised of adult female morphological measurements, larval habitats, reported blood hosts, and species-specific intraguild predation records. Currently, this database contains information for over 1,000 mosquito species (approximate  $\frac{1}{4}$  of all species), more than 100,000 blood host observations from >100 publications, and over 900 unique larval habitats for mosquitoes worldwide. This research incorporates the majority of mosquito genera including the major disease vectors in the genera *Culex*, *Aedes*, and *Anopheles*.

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**Student Authors (s):** Jackson, Amaya; North Carolina Central University

**Mentors (s):** Marshall, S. Alex; North Carolina Central University

### **THE EFFECTS OF ETIFOXINE ON ALCOHOL-INDUCED HIPPOCAMPAL NEURODEGENERATION AND BINGE CONSUMPTION**

Repetitive excessive alcohol consumption can result in the development of alcohol dependence, and lead to cognitive deficits caused by extensive brain damage. Treatments that reduces consumption and repair brain damage from binge-drinking could enhance the way of life for individuals with alcohol use disorders (AUDs). This study examined the effects of etifoxine (ETFX) on both alcohol-induced neurodegeneration and alcohol consumption. ETFX, an anxiolytic and anticonvulsant drug, demonstrates neuroprotective, neuroplastic, and anti-inflammatory properties. Its main mechanism of action is thought to be modulating the activity of GABA receptors, similar to ethanol. This study utilized the drinking in the dark (DID) model to measure the effects of ETFX on binge-like drinking. Following ETFX administration, there was a significant decrease in ethanol but not sucrose consumption in the DID paradigm. A 10-day intragastric gavage method was used to simulate an alcohol induced brain damage model (AIBD), while fluoro-Jade B (FJB) staining and cell counts were used to assess neurodegeneration. Cells were considered FJB positive (+) cells if they were fluorescent and displayed pyramidal cell body characteristics of neurons. Although ethanol increased the number of FJB+ cells, ETFX did not significantly reduce the number of FJB+ cells in the dorsal dentate gyrus. Together, these data suggest that ETFX may be a potential therapy for reducing ethanol consumption but may not be effective in ameliorating AIBD. Future studies will examine the effects of ETFX on intoxication behaviors and determine if AIBD in other hippocampal fields or brain regions, such as the entorhinal cortex, is reduced.

# Poster Presentations

## Business & Economics

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**Student Authors (s):** Cendejas, Abigail; Bobbitt, Tommy; Halickman, Kate; Queens University of Charlotte

**Mentors (s):** Cox, Steven; Queens University of Charlotte

### **The Effect of COVID-19 on Hospitality Industry Services**

With many consumers not traveling and avoiding public indoor spaces altogether, the hospitality industry has been hit badly by the COVID-19 pandemic. This research focused on changes to consumer expectations concerning hospitality services and amenities. Our research investigated which amenities such as pools, complimentary breakfast, toiletries, and housekeeping services, should be changed or eliminated. Additionally, the research investigated new services brought on by the pandemic, such as cleaning service changes and safety procedures which should be continued after the pandemic. The research methodology utilized an online survey and personal interviews with both consumers and people employed in the hospitality industry. The study was designed to help the hospitality industry make the appropriate changes in services to meet the new demands of customers during and after the COVID-19 pandemic period.

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**Student Authors (s):** Mitrecic, Sara; Burns, Katherine; Dorsey, Brianna; Queens University of Charlotte

**Mentors (s):** Cox, Steven; Queens University of Charlotte

### **Changes in the Acceptance of Athleisure Wear in the Workplace**

The research focused on changes to the athleisure market as a result of the COVID-19 pandemic. Working from home, closure of gym facilities, and the growth of teleconferencing have all affected the demand for athleisure products. Our research focused on changes in consumer attitudes toward the purchase and use of athleisure wear as a result of lifestyle changes caused by the pandemic. More specifically, the research investigated areas such as online shopping, brand selection, and acceptance of athleisure wear for work situations. Using an online survey, the research investigated consumer attitudes before, during, and expected future behavior toward the uses of athleisure attire. The results of the study were designed to understand changes in cultural dress norms and help athleisure brands understand the future directions of the market.

# Poster Presentations

## Chemical Sciences

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**Student Authors (s):** Kayali, Kayali; Gucciardi, Sophia; UNC Charlotte

**Mentors (s):** Rabinovich, Daniel; UNC Charlotte

### **Synthesis and Reactivity of a New Silver Thione Ligand**

Compounds of silver and other metals are frequently studied for the many benefits they can offer to human health. Such benefits include antibacterial and anticancer properties. Because of the relatively low toxicity of certain metals and low frequency of side effects observed in previous studies involving metallic complexes, such compounds show promise in developing metal-based anticancer drugs. The primary focus of this research is to synthesize metallic compounds and investigate their anticancer properties. This research project initially involves the synthesis of two N-heterocyclic thione ligands derived from a saturated diazepine (SDiaz) core and having bulky aryl substituents on the nitrogen atoms. The bulky aryl groups are defined as a 2,6-dimethylphenyl which is referred to as a Xylyl group (Xy). Because sulfur is effective in binding metals to molecules, it can be used to synthesize SDiazXyS ligands which are reacted to silver (I) salts, mercury iodide, and elemental iodide. These generate new compounds with formulas such as  $[(\text{SDiazArS})_2(\text{HgI}_2)_3]$ ,  $[\text{Ag}(\text{SDiazXyS})_2]\text{NO}_3$  and  $[(\text{SDiazXyS})\text{I}_2]$ . This presentation will describe the preparation of these compounds as well as their characterization using nuclear magnetic resonance (NMR) spectroscopy and elemental analysis, among other techniques. Future work includes the characterization of some of these species using X-ray crystallography and a study of their anticancer properties with the ultimate goal of progressing cancer research.

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**Student Authors (s):** Mattena, Katherine; Barton College

**Mentors (s):** Bing, Darryl ; Barton College

### **“Demonstration of Gluconeogenesis via Microbial Fuel Cell Technology”**

For the past two years, this laboratory has been studying the design and the applications of microbial fuel cells (MFCs) for the practical conversion of biomolecules (e.g. carbohydrates) into electricity. Work has been previously presented demonstrating how microbes – i.e. yeast and bacterial cells could metabolize carbohydrates of varying complexities to yield an electrical potential. The results of the research raised the question, “Does MFC technology offer a novel approach to teaching metabolism?” Evidence is now being presented showing that through MFCs, proteins may also serve as the fuel source to yield electricity. Even more compelling, this body of research also represents a real-time demonstration of gluconeogenesis. In general, living cells require glucose as the primary metabolic fuel for survival. However, when glucose is unavailable, cells possess the capacity to produce glucose from non-carbohydrate sources (i.e. gluconeogenesis). In this project, various proteins were placed into an MFC inoculated with *E. coli* and, over a specific time course, an electrical potential was generated. It is the hypothesis of this lab that the potentials generated are dependent on the amino acid sequences of the proteins used. Amino acids classified as glucogenic undergo gluconeogenesis to yield and may, therefore, be metabolized to yield electricity. The fact that an electrical potential can be visually observed indicates that gluconeogenesis is also being observed in real time.

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**Student Authors (s):** Sutariya, Shyam; Mills, Samantha; East Carolina University

**Mentors (s):** Beltran-Huarac, Juan; East Carolina University

**Evaluating the physiochemical properties of nitro dopamine PEGylated superparamagnetic iron oxide nanoparticles for theranostic applications**

Lack of targeting selectivity in breast cancer is the main challenge for clinical applications of superparamagnetic iron oxide nanoparticles (SPIONs). In this project, monodispersed SPIONs were synthesized by a straightforward, reproducible, and chemical method. To enhance targeting selectivity, the surface of SPIONs was modified using nitro dopamine PEG (ND-PEG/SPIONs) via exchange ligand and grafting-to approach. FTIR spectra confirmed the interaction of PEG with SPIONs. TEM and XRD analyzes revealed uniform spherical morphology, size, phase and crystallinity before and after the polymeric coating. DLS was used to determine hydrodynamic size distribution, agglomeration state and zeta potential in different physiological media. The results showed that ND-PEG/SPIONs are colloidally stable and free of endotoxins. VSM studies showed the typical superparamagnetic ordering of ND-PEG/SPIONs at room temperature. The biocompatibility of ND-PEG/SPIONs was evaluated via metabolic activity and live/dead viability assay using a breast cancer model in absence and presence of exogeneous magnetic fields, which indicated that ND-PEG/SPIONs are non-toxic up to 400 µg/mL. Therefore, ND-PEG/SPIONs exhibit great potential for magnetic therapy and suitable for theranostic applications.

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**Student Authors (s):** Barbare, Daniel; Fayyad, Firass; Ezenwenyi, Ifeanyichukwu; Sullins, Daminike; North Carolina Central University

**Mentors (s):** Christian, Omar; North Carolina Central University

**Friedel-Craft Acylation of Phloroglucinol**

Vismiaphenone B is a member of the prenylated benzophenone family of metabolites isolated from *Vismia decipiens* and *Clusia ellipticifolia*. These metabolites are biologically significant displaying a range activity against targets including HIV and cancer. As a part of our organic chemistry II laboratory program a synthetic strategy for the preparation vismiaphenone B was undertaken. En-route to the preparation of the 2,4,6 trihydroxybenzophenone a precursor to vismiaphenone B, utilizing the Friedel-Crafts acylation of phloroglucinol, the unexpected side product 2,4-dibenzoylbenzene-1,3,5-triol was synthesized. The synthesis as well as structure elucidation of the products of this reaction is discussed.

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**Student Authors (s):** Vo, Wendy; UNC Charlotte

**Mentors (s):** Rabinovich, Daniel, Juan; UNC Charlotte

#### **Synthesis and Characterization of a New N-Heterocyclic Thione**

This presentation describes the synthesis of a new N-heterocyclic thione (NHT) ligand based on a saturated 1,3-diazepine core and 2,4,6-trimethylphenyl (mesityl) substituents on its nitrogen atoms. The characterization of the new SDiazMesS ligand relies on a number of analytical and spectroscopic methods, including elemental analysis and nuclear magnetic resonance (NMR) and infrared (IR) spectroscopies. This presentation also outlines our initial reactivity studies with the SDiazMesS ligand, including the preparation of mercury(II) and silver(I) derivatives. In particular, homoleptic silver(I) compounds of general formula  $[\text{Ag}(\text{SDiazMesS})_2]^+$  are likely to exhibit anticancer activity, which is a driving force for this project. A comparison of the reactivity of different but closely related SDiaz-ArE ligands (Ar = Xy, Mes, Dipp; E = S, Se) will be also discussed in this presentation.

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**Student Authors (s):** Kalogeromitros, Maria; UNC Charlotte

**Mentors (s):** Rabinovich, Daniel, Juan; UNC Charlotte

#### **N-Heterocyclic Thione Complexes of Silver with Potential Anticancer Activity**

For many years, silver compounds have been routinely used in medicine in wound dressings, antiseptics, and antibiotics due to their antibacterial properties. In the past few years, the potentiality of silver compounds in cancer treatments has also emerged. In this presentation, we describe the synthesis of a novel N-heterocyclic thione (NHT) ligand SDiazDippS, where Dipp = 2,6-diisopropylphenyl, and its silver(I) complexes  $[\text{Ag}(\text{DiazDippS})_2]\text{X}$  (X =  $\text{NO}_3$ ,  $\text{BF}_4$ ,  $\text{ClO}_4$ ). The complete characterization of the three desired silver(I) compounds, including the use of nuclear magnetic resonance (NMR) spectroscopy and elemental analysis to assess the purity of the isolated products, will be discussed in this presentation. Future efforts will focus on testing the biological activity of these complexes, especially against several cancer cell lines.

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**Student Authors (s):** Vincent, Marissa; Bare, Alex; Barras, Jake; Wood, Jackson; UNC Wilmington

**Mentors (s):** Lee, Soon Goo, Juan; UNC Wilmington

**Biochemical and structural analysis of aromatic aldehyde dehydrogenase B from *Pseudomonas syringae* DC3000**

Bacterial pathogen *Pseudomonas syringae* strain DC3000 produces indole-3-acetic acid (IAA) to suppress host defenses and to promote infection of target plants. Previously, we identified three aldehyde dehydrogenases (ALDs) from *P. syringae* DC3000 using microbial genome sequences and computational analysis tools. Recent work demonstrated that a NAD-dependent aldehyde dehydrogenase A (AldA) mainly produces pathogenic IAA from indole-3-acetaldehyde (IAAld). Although each ALD shares a common reaction mechanism, substrate specificity varies. To better understand the role of active site residues and substrate specificity of each ALD, we examined the three-dimensional structures and biochemical activities of AldA and aldehyde dehydrogenase B (AldB). To examine the effect of changes in the aldehyde substrate binding site, twenty point mutations were generated by site-directed mutagenesis. The His-tagged recombinant proteins were expressed and purified by nickel-affinity chromatography. Steady-state kinetic analysis was used to analyze the effect mutations on activity and substrate specificity for IAAld and other aromatic aldehyde substrates. The X-ray crystal structure of AldB and biochemical analysis provide insights on the evolution of enzyme and molecular architecture in the IAA biosynthetic pathway of bacterial pathogen *P. syringae*.

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**Student Authors (s):** Gerber, Bronté; Harrison, Lyndsay; East Carolina University

**Mentors (s):** Hvastkovs, Eli; East Carolina University

**Sugar Pills? Utilizing liquid chromatography-tandem mass spectrometry for an in-depth look at Humphreys' Specifics**

Frederick K. Humphreys founded the Humphreys' Homeopathic Medicine Company during the rise in acceptance and popularity of homeopathy in the United States, rivaling that of orthodox medicine. Generally, homeopathy sought to individualize each treatment while allopathy followed the scientific trends of the period, leading to a lack of standardized principles. The relatively high cost and low success rate of allopathy furthered the popularity of homeopathic medicine, despite the claims of false advertisements and criticisms found scattered throughout a slew of patient success stories. In order to determine the validity of Humphreys' treatments, which were marketed by specific illness (i.e., Piles, Diarrhea, Diphtheria, etc.), the components of each were identified using mass spectrometry (MS) techniques. Tandem mass spectrometry analysis (MS/MS) was used to pinpoint similarities in the ingredients of four "specifics" sold by Humphreys' company. Following the preparation of the samples in an environment that mimicked stomach acid, positive ion mode MS was used to acquire initial base peak ions and identify the unknown components. The spectra showed similar base peak ions for each pill, leading to the hypothesis that all four samples contained the same basic ingredients. Further MS/MS analyses identified these base peak ions as adduct peaks of sucrose, its related ions, and apigenin in each of the advertised remedies analyzed. Overall, through the analysis of Humphreys' Specifics, when combined with historical context, a more complete framework of homeopathy could be formed to scientifically contextualize the popularity and rise of this alternative regimen during the late 19th century.

**Student Authors (s):** Eakes, Remington; East Carolina University

**Mentors (s):** Banerjee, Sambuddha; East Carolina University

### **The Trojan Horse Approach to Combatting Antibiotic Resistance in Gram-Negative Pathogens**

The bacterial outer membrane (OM) provides a barrier towards the transport of nutrients and other molecules coming inside the cell. As a result, bacteria express uptake systems where outside materials are either transported in through an active process (such as siderophore transporters) or passive processes (such as porins). Antibiotics cross bacterial membrane using porins, however, due to overuse and misuse of these drugs bacteria has evolved efficient efflux pumps to detoxify itself. On the other hand, nutrients like iron is taken up as Fe<sup>3+</sup>-siderophore complexes (siderophores are Fe<sup>3+</sup> binding small molecules produced by bacteria) using high-affinity transporters and expression of these transport systems are often essential for the viability of the bacteria. Taking these two together, a strategy to overcome antibiotic resistance would be to introduce antibiotics utilizing the OM Fe<sup>3+</sup>-siderophore receptors. In this work, an anti-malarial drug molecule, artesunate, is chemically conjugated to a siderophore, 2,3-Dihydroxybenzoic acid (DHBA), using ethylenediamine as a linker. Several drug-resistant pathogen use DHBA as their natural siderophore and siderophore-drug conjugates using artesunate has been reported earlier. The synthesized molecule has been confirmed using proton 1H-NMR and ESI mass spectroscopy. The conjugate is now being tested on *Brucella* spp. To test its antibacterial activity. The second phase of this project is to use cleavable linkers. The advantage of using cleavable linkers is that it opens up the possibility of new types of drugs that can be transported into the cytosol after the peptide-drug bond is cleaved in the periplasm. The plan with this project is to create a library of siderophore-drug conjugates with cleavable and non-cleavable linkers to try and combat the rising problem of antibiotic resistance.

**Student Authors (s):** de Andrea Pereira, Mariana; Dellinger, Alexander; Ross, Michael; Sheliakyn, Roman;

**Gaston College**

**Mentors (s):** Maggiotti, Virginie; Gaston College

### **Do Heavy Metal Pollutants Contribute to the Development of Antibiotic Resistance in the Catawba River Basin?**

Bacterial resistance to antibiotics poses an ever-increasing threat to human health, with higher numbers of pathogenic bacteria displaying resistance or decreased susceptibility to commonly used antibiotics. Research efforts have identified the role that the environment may play in the spread of Antibiotic Resistance Genes (ARGs). Surface water microbiomes in metropolitan areas may act as a hotspot for environmental ARG propagation due to pollutants that may increase the positive selection pressures of ARGs. Wastewater effluent acts as a vector for many of these pollutants, often containing sub MIC levels of Antibiotics. This study aims to provide valuable data on the levels of ARGs and Antibiotic-Resistant Bacteria in the Catawba River Basin, a North Carolina River System which spans 225 miles and supplies drinking water to roughly two million residents. A total of 12 collection sites on the river spanning the Charlotte-Metropolitan area were chosen based on ease of public access and proximity to pollution sources. The samples were tested for a range of ions, including ammonium, nitrate, arsenic, chromium, copper, iron, and nickel. All values tested were found to be well within EPA limits, but they will be monitored year-round to assess the impact of farming and industrial pollutants on the quality of the water.

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**Student Authors (s):** Carolla, Catie; Dykes, Rachel; Falls, Ashlee; Roach, Joshua; UNC Wilmington

**Mentors (s):** Lee, Soon Goo; UNC Wilmington

### **Studying the formation of the steviol glycoside biosynthesis pathway in biochemistry**

The steviol glycoside biosynthesis pathway, that was studied in this project, has an important role in generating future variations of noncaloric sweeteners. Steviol glycosides are extracted from the leaves of the plant *Stevia rebaudiana* (Bert) Bertoni from Paraguay, South America. The sweetness of this particular plant is associated with the accumulation of steviol glycosides located in the plant's leaves. This natural sweetener is known to taste almost 300 times sweeter than sucrose. The two main types of glycosides from this plant are stevioside and rebaudioside A. The biosynthesis pathway of steviol glycoside mainly involves the conversion of steviol glycosides to rebaudioside A by the enzymes uridine-diphosphate glucosyltransferases (UGT). Through the use of protein purification, biochemical analysis of enzymatic activity and binding, and structural analysis through the use of X-ray crystallography, the importance and understanding of this pathway will be analyzed, along with the health benefits of this noncaloric sugar substitute.

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**Student Authors (s):** Brotherton, Andrew; UNC Charlotte

**Mentors (s):** Walter, Michael; UNC Charlotte

### **Aqueous Thiazolothiazole Derivatives for Electrochromic, Electrofluorochromic, and Photochromic Multifunctional Devices**

Electrochromic materials change color when electricity is applied to them, which are useful for applications like smart windows, auto-dimming mirrors, and wearable electronics. For windows, a voltage can be applied to make the material darken, lessening the amount of light into the room, eliminating the use of blinds or curtains. This also reduces energy costs by decreasing the amount of solar heat in a building, where light goes through windows, gets trapped and creates heat, causing the need for indoor climate control. Currently, Boeing has electrochromic windows in the 787 Dreamliner to get rid of shades, however, like a lot of electrochromic materials, they are made of expensive and harmful materials and lose color intensity over time. In this study, water-based electrochromic thiazolothiazole (TTz) compounds are synthesized to be stable, cheap, and safe alternatives to current systems. Our TTz changes color when exposed to light and switches on and off fluorescence which is useful in sensors or electronic displays. These newly made TTz compounds are characterized in a gel made of polyvinyl alcohol and borax. This grade school demonstration typically uses food dye, however, it is replaced with the TTz dyes, which can gain two electrons, changing its color from colorless to purple to blue depending on the voltage. The color changing intensity, on/off speed, durability, and cyclability are tested with different thiazolothiazole dyes to understand which compounds have the highest color change and reversibility while creating a safe water-based system that performs comparatively to its expensive and hazardous counterparts.

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**Student Authors (s):** Atkinson, Stephanie; North Carolina State University

**Mentors (s):** Vinueza, Nelson; North Carolina State University

### **Dyeing the World Green: A Study of How Water and Other Liquids Affect the Photodegradation of Disperse Dyes**

Azo compounds possess the structure  $R-N=N-R'$  and are commonly used in the textile industry. Previous studies have shown that azo dyes break down at their azo bonds by photodegradation forming toxic aromatic compounds. However, our results from high resolution mass spectrometry (MS) and molecular modeling of the dye Disperse Red 1 indicated that the major photodegradation products were based on the breakage within the dye's arylamine group. The photodegradation mechanism proposed previously for disperse dyes was investigated using density functional theory (DFT) calculations. The reactivities of these dyes for both the ground and excited states, and for the cis-to-trans transition were determined. A trend was seen in the reactivity of the studied azo dyes, in which the trans isomers were generally most susceptible to radical attack at their amino end groups, while the cis isomers were more reactive at their azo bonds. Previously, it had not been studied how these dyes would change their photodegradation mechanism when put into solution instead of on fabric as in solution could simulate wastewater. From the analyses of ethyl acetate solution dyed with DR1 and photodegraded for different time intervals, a general photodegradation pathway was solidified for DR1 and correlated with previous results with poly(ethylene terephthalate) dyed fabric as well as correlating with molecular modeling results. Thus, modifying the molecular structure and the medium in which azo dyes are found may allow for control of the location and mechanism of photodegradation, so that fewer harmful aromatic compounds are released into the environment.

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**Student Authors (s):** Zhin, Zaneta; UNC Charlotte

**Mentors (s):** Vivero-Escoto, Juan; UNC Charlotte

### **Functionalization Effect on the Photodynamic Therapy of Polyhedral Oligomeric Silsesquioxane Derivatives**

Polyhedral Oligomeric Silsesquioxane (POSS) is an organic-inorganic nanocomposite popularly used in biomedical treatments, such as anti-cancer therapy to target cancer cells. Known for its compatible nanoscale size, low toxicity, efficient cellular uptake, and high solubility, POSS have been used to enhance the outcome of photodynamic therapy (PDT). Light activation of photosensitizers (PS) in PDT leads to cell death due to toxicity resulting from singlet oxygen. However, PS are insoluble in aqueous media leading to self-quenching, decreased phototoxicity and aggregation minimizing the chance to target cancer cells. In this project, a multi-step synthesis of POSS molecules with porphyrin (POSSP) are synthesized and characterized with various functional groups such as isobutyl, phenyl, aminopropyl and methylated aminopropyl. The effect of POSSP conjugates favorably enhanced the singlet oxygen quantum yield with the evaluation of phototoxicity against cancer cells that showed similar trend in PDT effect as the singlet oxygen quantum yield. Overall, we have shown that tuning the functional groups on POSSPs can improve the PDT effect.

# Poster Presentations

## Communication & Journalism

405

**Student Authors (s): Kabia, Zainab; Johnson C. Smith University**

**Mentors (s): Moore, Dakysa; Johnson C. Smith University**

### **From Boys to Men: The Black Male Experience in the Films Moonlight and The Wood**

African American males in the United States have endured disadvantages that have stemmed from society's environmental circumstances. Regardless of what some may argue is the marginalization, partly, established by the media and entertainment industry, these young males have managed to challenge the obstacles placed upon them and conform to their own kind of development and success. The purpose of this study is to understand the relationships and images depicted of black males in popular films such as The Wood and Moonlight. While using a thematic analysis to conduct this research, the researcher discovered the themes of coming of age, love, and adoptive family.

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**Student Authors (s): Moon, Exodus; Johnson C. Smith University**

**Mentors (s): Moore, Dakysa; Johnson C. Smith University**

### **Telling My Story: Representations of Murdered African American Transgender Women**

One of the most underreported trends in the (Lesbian, Gay, Bisexual, Transgender, Queer) LGBTQ community is the high rate at which transgender people, especially transgender women of color, are being murdered. Media representation plays a significant role in the influence and the societal perception of how people view transgender women of color. This study seeks to understand how transgender women of color are framed on the television series Fatal Attraction. The researcher explored two episodes on the series, which reenacts true life crime events against two transgender women. The researcher critically analyzed both episodes applying the framing analysis annotating detailed notes and identified common themes of improper pronoun usage, birth name vs chosen name, and intimate partner violence to explore the representations of transgender women on the show.

# Poster Presentations

## Computational Sciences

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**Student Authors (s):** Wiseman, Kyle; High Point University

**Mentors (s):** Pittman, Jason; High Point University

### **A Knock in the Dark - Detecting Port Knocking on IPv4 Networks**

Computers connected to a network such as the internet are vulnerable to attack. Often, the initial step an attacker will take is to scan for available services. Once a service such as remote access is discovered, the attacker will craft an exploit and compromise the computer. One way to prevent this scenario is by not exposing services to the network in the first place. Of course, a computer without available services is not very useful. Port knocking is a technology which keeps services concealed until a client sends a specially crafted communication sequence or \*knock\*. The good news is that services protected by port knocking are rather safe. The bad news is that the knock, according to the literature, can be captured and replayed in order to gain unauthorized access. However, to date, there has not been a technical examination of what port knocking looks like on an active network, whether the knocking action is sufficiently different inside normal traffic that an attacker could recognize the use of port knocking, and whether the knock sequence can be distinguished from typical network communications. Accordingly, in this work we experimentally demonstrate port knocking under several network conditions. The goal is to provide a practical foundation based on existing theoretical ideas in the existing research.

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**Student Authors (s):** Sud, Neil; North Carolina School of Science And Math

**Mentors (s):** Robert Gotwals; North Carolina School of Science And Math

### **Understanding the Drug Characteristics and Protein Structure of the mTOR Pathway and Rapamycin Using StarDrop**

Aging is a part of human life. As people get old, it is common for them to experience difficulties with vision, hearing, and daily activities. Furthermore, aging increases the risk of numerous diseases, including cancer, type-2 diabetes, and Alzheimer's. When looking at ways to combat these diseases and aging-effects in general, it's important to look at the mTOR protein. It regulates growth, proliferation, and survival, and the inhibition of the mTOR protein results in significant anti-aging effects and the promotion of longevity. Inhibiting the mTOR protein is where Rapamycin comes into play. Rapamycin, also known as Sirolimus, is a chemical compound known to inhibit the mTOR protein. Testing has shown that Rapamycin increases various organisms' longevity, such as worms, mice, and yeast. Currently, Rapamycin is an FDA-approved drug used as an immunosuppressant; however, it can potentially be an effective anti-aging drug for humans. The challenge with implementing Rapamycin is that it has multiple side effects that limit its use as a human anti-aging drug. To understand these side effects, this project uses the computational tool, StarDrop, to analyze the drug characteristics and protein structure of the mTOR pathway and Rapamycin. The results show that Rapamycin does not adhere to the five StarDrop drug scoring profiles. The paper also takes a more in-depth look at Rapamycin's binding spots to different protein binding spots. This paper's results are preliminary for developing a larger project and future research as there are countless applications and possibilities with the mTOR protein and Rapamycin.

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**Student Authors (s):** Riccardelli, Justin; Hanks, Ashlyn; Beal, Timothy; Haramis, Christos;

**High Point University**

**Mentors (s):** Pittman, Jason; High Point University

### **Detecting Network Characteristics of Dynamic Honeypots**

A honeypot is an intentionally vulnerable computing system designed to entice attackers into revealing tools and techniques. The purpose of honeypots is to allow the study of these tools and techniques so that future safeguards can be developed. Potential attackers are aware of this and therefore have an interest in detecting honeypots to avoid such systems. One reported mechanism to find if the target system is a honeypot involves analyzing various detection characteristics. However, existing research is not clear on what network or system attributes constitute detection characteristics. To that end, we set out to reproduce a specific honeypot detection study containing both a theoretical model as well as a validation experiment. Having an experimentally verified list of detection characteristics would enable cybersecurity professionals to implement deception technologies covertly. Moreover, because of our findings, honeypots may be more concealable which means researchers can study adversaries in more depth.

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**Student Authors (s): Mantena, Sriya; North Carolina School of Science And Math**

**Mentors (s): Robert Gotwals; North Carolina School of Science And Math**

### **Investigating the Geometric Determinants of Hemodynamics in Carotid Artery Stenosis for Stroke**

#### **Prediction**

Stroke is the fifth leading cause of death in our modern world, and 25\% of strokes result from carotid artery stenosis (CAS) which is the narrowing of the carotid arteries caused by a buildup of plaque. Clinical decision-making and the assessment of stroke risk mainly depend on the degree of stenosis, but many patients with severe CAS never suffer a stroke, and strokes can occur even with only moderate stenosis. This suggests that geometric factors apart from severity may be important in determining stroke risk. In this study, we investigate the effect of eccentricity and tortuosity with a co-dependence on the severity of the stenosis. 3-D tetrahedral meshes were created for 16 CAS cases. We used a computational fluid dynamics model based on a hyperelastic finite element extension of the immersed boundary method for fluid-structure interaction (FSI) to simulate blood flow throughout these geometries. We identified post-stenotic recirculation zone size and location, and spatial extent of elevated wall shear stress as key factors differing between stenoses with varying tortuosity and eccentricity. Using Spearman correlations, we also found a strong negative relationship between tortuosity and time-averaged wall shear stress in stenoses with >65\% severity ( $p < 0.05$ ). Our results suggest that accuracy of stroke prediction and clinical decision making in CAS can be improved by the consideration of eccentricity and tortuosity in addition to the degree of stenosis, benefitting clinicians, and patients alike.

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**Student Authors (s): Jain, Amisha; North Carolina School of Science And Math**

**Mentors (s): Riehn, Robert; North Carolina State University**

### **Tracking Ant Interactions Using Object Detection and Pose Estimation**

As the human population grows, we may face a lack of natural resources, potentially leading to global conflict. *Solenopsis invicta*, commonly known as the imported fire ant, is a well-researched, accessible species in which ants fight other colonies to defend their own. Tracking ant interactions can yield insight into population interactions brought about by overpopulation. However, before observing multiple ant colonies we must develop an efficient method of tracking ant interactions within a single colony. Using ant image datasets, an AI tool can be trained with either object detection or pose estimation to recognize ant movement. Object detection was accomplished with bounding boxes, and pose estimation with a keypoint model and instance segmentation mask. After either annotation method, the AI tool was trained with the Faster R-CNN deep learning network model in PyTorch, using the Res-Net50 backbone. For pose estimation, white sand replaced the natural dirt background in order to accurately use the keypoint model. The mask was an additional annotation used because keypoint alone could not easily localize ant objects. It was found that object detection correctly tracked ant movement 50 percent of the time, though ant interaction tracking is less detailed than pose estimation. Because of their detail, pose estimation annotations were quite tedious; it also takes longer to train the AI tool. However, fewer annotations are needed to produce results compared to object detection. Combining both methods can result in efficient tracking of ant behavior within multiple colonies, such as recruitment, mortality rates, and spatio-temporal dynamics.

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**Student Authors (s):** Hoffpauir, Kyle; Markle, Nathan; Meadows, Carmeon; High Point University

**Mentors (s):** Pittman, Jason; High Point University

**Primer - A Dynamic Honeypot MoE Tool**

Honeypots are vulnerable computing systems deliberately exposed to the public to attract attackers. The mission of a honeypot is to capture attackers' behaviors so that cybersecurity researchers can analyze the information and develop better defensive technologies. However, prior research has found there is little quantitative validation of effectiveness which leaves professionals, researchers, and educators without the means to know whether a honeypot is effective in its implementation. To that end, we previously developed a taxonomy to model the features or characteristics of dynamic honeypots which ought to serve as specific measures. Building on this model, we now present a novel software tool to generate identical, realistic usage in target honeypot measures of effectiveness characteristics. In doing so, researchers and practitioners may have a mechanism to evaluate discrete honeypot implementations identically.

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**Student Authors (s):** Grinberg, Jacob; North Carolina School of Science And Math

**Mentors (s):** Herndon, Nic; East Carolina University

**SEED: Sparse Environment Exploratin using Demonstrations**

When learning, we should be able to incorporate prior information about a task in addition to the reward we receive in conducting the task. Current solutions create models of the environment. However, model-based learning requires hard-coding from the researcher and is specific to the chosen environment. Model-free learning is much more general, but quantifying prior knowledge in this case is abstract. As such, new research in model-free learning focuses on either learning from reward or from demonstrations, but not both. We outline a process by which these two methods can be combined, named Sparse Environment Exploration using Demonstrations (SEED). Initially, SEED trains an imitation learning (IL) agent and a discriminator using Generative Adversarial Imitation Learning (GAIL). SEED then trains a reinforcement learning (RL) agent, using KL-Divergence to minimize the distance between the IL and RL policy, and a novel idea of employing the discriminator to push the RL policy to explore state spaces not encountered by the IL agent. The process is akin to pushing and pulling between the demonstration data, while utilizing the environment reward as a guide. This process has shown promise in solving sparse environments, where reward density is extremely low. Moreover, it has sped up training in PyBullet environments such as InvertedPendulum.

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**Student Authors (s): Shaw Ronessa; Elizabeth City State University**

**Mentors (s): Hayden Linda; Elizabeth City State University**

**Pertaining to research internships**

We received various tutorials on numerous websites and the functioning behind them. New websites that were introduced to me included Google Cloud, Docker, Xsede user portal, Jetstream and Apache Airavata. Google cloud is used to provide access to users to construct and run software online, Docker allows the user to run an application within a container, Xsede is a system that is often used by scientists to share data and computing resources. Airavata is a software that allows users to create, manage, execute and monitor large applications. We then implemented a project. Each participant within the program was assigned to three different groups and the goal was to create a website based upon covid-19, selection on what to discuss Pertaining to covid-19 was strictly based upon what the group decided on. I was a part of Hubzero. We created an interactive map with the data for US and its territories. There were layers to show the ratio of active cases to the confirmed cases or deaths as well as layers showing bed location locally. The next internship was pertaining more so to the psychological field. It was completed through department of homeland security funding and objectives of this project was to study how hurricanes cause mental trauma.

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**Student Authors (s): Paimagam, Akshra; North Carolina School of Science And Math**

**Mentors (s):**

**Enhancing tumor detection accuracy in mammograms of patients with dense breast tissue using machine learning methods and image processing techniques**

Breast cancer is the second leading cause of cancer mortality in women, contributing to roughly 40,000 deaths annually in the United States. Women with dense breast tissue have an increased risk of developing aggressive breast cancer, as opposed to those with fatty breast tissue. This is attributed to surplus glandular tissue, which obscures visualization of abnormalities, and radiologists' visual fatigue from examining overwhelming numbers of mammograms. These factors contribute to the disparity of breast cancer diagnosis accuracies, with 80-98% accuracy for women with fatty breasts but only 50% for those with dense breasts. The negative psychological ramifications that false positive mammogram results have on patients prompted this study on developing and optimizing the accuracy of computational algorithms used for the diagnosis of breast cancer. An Android application, based on a graphical user interface (GUI), was devised to act as a supplemental tool for breast cancer diagnosis. The app analyzes pixel values, detects tumor edges through contour detection, and classifies tumors as malignant or benign through a machine learning model. The highest-performing algorithm for dense breast tissue was random forest classifier, producing a diagnostic accuracy of 84.75%, as well as the near highest sensitivity of 82.58% and specificity of 87.33%, suggesting few false negative and positive results. These results demonstrate an improvement in diagnostic accuracy with the app from traditional mammography, showing that the app holds promise as an aid to help doctors improve detection and classification accuracy.

# Poster Presentations

## Cultural & Language Studies

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**Student Authors (s):** Mowery, Samatha; North Carolina State University

**Mentors (s):** Jordan, Chad; North Carolina State University

**From NC State to Down Under: A Study Abroad Experience at the University of Adelaide**

Study abroad experiences provide undergraduate and graduate students with the opportunity to grow personally, academically, and professionally through exposure to different cultures and academic settings. In the spring of 2019, I traveled to Adelaide, South Australia, to participate in a semester-long study abroad experience at the University of Adelaide. Through this experience, I had the opportunity to enroll in four unique courses at the University of Adelaide, all of which contributed to the development of my knowledge of science and culture. In addition to courses, I participated in various extra-curricular activities, including travel to New Zealand, university club meetings, and university social events. Participation in humanities courses and social events at the University of Adelaide was an integral part of my study abroad experience. These experiences allowed me to better immerse and educate myself about Australian culture and diversity. Ultimately, the combination of cultural immersion, academic participation, and extra-curricular involvement significantly contributed to my personal, academic, and professional growth and development. By sharing my experience, I hope to encourage other students to explore study abroad experiences, as they can enrich one's life in many ways.

# Poster Presentations

## Education

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**Student Authors (s):** Ellison, Ce'Ondra; Duke University

**Mentors (s):** Dunston, Yolanda; North Carolina Central University

**University-Assisted Community Schools**

This project was created to establish an equitable and sustaining partnership between Duke, North Carolina Central University (NCCU), and Durham Public Schools (DPS) by understanding the Community Schools and University Assisted Community Schools models, understanding community-driven and community-responsive actions for school reform, and conducting assets and needs assessments (ANAs) to improve DPS-facing initiatives at Duke and NCCU. The ANA involved 60 peer interviews with NCCU and Duke students, focus group interviews with 10 DPS educators and 20 NCCU and Duke faculty and staff interviews. The data revealed that while undergraduate students had a clear intrinsic motive for engaging in local schools, there was a gap in training and preparation with regard to cultural competency training, context-setting, and content and teaching strategy. The project is currently working to conduct additional analysis, refine asset maps of resources at Duke and NCCU, and compile a database to match community identified needs.

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**Student Authors (s):** Poston, Anna; North Carolina State University

**Mentors (s):** Hartley, Jenna; North Carolina State University

**Picking up more than just litter: Emboldening teachers' confidence through a citizen science based marine debris curriculum**

Citizen science is an emerging method for enhancing classroom teaching (Bonney et al., 2016), developing students' scientific efficacy (Volk & Cheak, 2003), strengthening students' sense of place and critical thinking skills (Jenkins, 2011) and building scientific literacy (Vieira & Tenreiro-Vieira, 2016). However, teachers need confidence in their capacity to teach citizen science to develop these positive outcomes (Scott, 2016). This study explores preliminary elementary teacher outcomes around confidence teaching with citizen science after participating in a one-year, citizen science based marine debris curriculum with support from program staff and researchers. Our study was conducted using a mixed methods approach, specifically, we employed a qualitative embedded design in which we conducted a quantitative pre-test, followed by a qualitative process, and finished with a quantitative post-test. For our quantitative data, we distributed pre- and post-surveys to both treatment and control teachers. In between quantitative survey collection, we conducted 5 focus group interviews with 16 of the treatment teachers. We then analyzed all of the data using Stata 14.2 (quantitative data) and NVivo (qualitative data) to elucidate nuanced and quantifiable teacher outcomes. Citizen science offers many positive outcomes for student learners, but in order to enhance those student outcomes, more information is needed on how to best prepare teachers for implementing citizen science into their classrooms. More confident teachers might be better equipped to nurture empowered, capable, and confident students of citizen science, thereby enhancing positive student outcomes in and out of the classroom.

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**Student Authors (s):** Patrick, Allison; High Point University

**Mentors (s):** Vess, Sarah; High Point University

**Parent-Child Interaction Therapy (PCIT) for Families of Children with Autism Spectrum Disorders (ASD)**

Approximately 1 in 59 children are diagnosed with Autism Spectrum Disorder (ASD) each year. Children with ASD exhibit impairments in communication, social interaction, and ritualistic and/or repetitive behaviors. Associated behavioral symptomatology can be a significant stressor for families of children with ASD. Accordingly, there is a growing body of research which suggests interventions should target family stressors. While Applied Behavior Analysis (ABA) has the most empirical support as an intervention, there is support for the use of Parent Child Interaction Therapy (PCIT), a relationship-based, naturalistic intervention. The purpose of this study is to test the efficacy of PCIT, without modifications, with families of preschool-age children with ASD without comorbid behavioral difficulties. This study addresses these questions: What effect will PCIT have on parental competence? What impact will PCIT have on the parent-child relationship? Will PCIT affect child functioning? The study utilized a multiple baseline research design with four families of children with ASD. Each family participated in both phases, and the mothers completed pre- and post-treatment questionnaires regarding parenting practices, the parent-child relationship, and attitude toward therapy. The results indicate support for the use of PCIT for the aforementioned population. Mothers demonstrated more positive and effective parenting behavior while enhancing the parent-child relationship. The children were more compliant to commands and had improved social and behavioral functioning. This study contributes to the growing body of literature documenting the benefit of PCIT without modifications for children with ASD by validating that it can be effective for this population.

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**Student Authors (s): Parkash, Priya; Duke University**

**Mentors (s): Wood Crowley, Jenette ; Duke University**

**Motivations for the pursuit of STEM amongst US bound Kenyan students: A case study of students enrolled in college access programs like KenSAP**

Much warranted attention over the past few decades has been devoted to the problem of retaining minorities, particularly women, in areas where they are poorly represented such as in science, technology, engineering, and mathematics (STEM) fields. Race and ethnicity are salient factors in STEM retention and minorities comprise fewer than 1 in 10 scientists or engineers. However, minimal, if any, attention has been directed towards the motivations for the pursuit of STEM and STEM retention amongst international students. This study specifically seeks to examine the motivations for the pursuit of STEM amongst US bound Kenyan students and use both, qualitative and quantitative methods to identify factors that motivate the pursuit of STEM within four broad themes: financial correlations, cultural attitudes, US foreign policy, and STEM identity. The goal of this study is to advance knowledge on international students in their pursuit of STEM careers; it aims to provide information about the impact of societal and cultural aspects as well as attitudinal, character and educational achievement in the career selection process and persistence in the STEM disciplines for international students. Although, currently the study focuses on Kenyan enrolled in a US college access program called KenSAP, I hope to be able to expand this research to several developing countries over the years, which may have implications for higher education practices and support US institutions in their drive to better understand and develop strategies for the successful retention of international students in STEM.

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**Student Authors (s): Cornette Cook, Marley; North Carolina State University**

**Mentors (s): Silverberg, Larry; North Carolina State University**

**Ellipsoid**

Introductory physics concepts can be explained through shared past experiences. You feel air resistance when riding a bike, and friction when going down a slide. But higher level classes focus on topics that lack this grounding. Behavior on the galactic and quantum scales can feel random and unintuitive. It may be possible to develop an intuitive understanding for these topics using simulations. I have developed an educational tool that focused on Orbital mechanics to achieve this goal. This physics based game consists of a series of puzzles. Each level focuses on a specific concept, which the student will need to implement to proceed. I linked surveys in both the beginning and end screens of the project to measure its effectiveness as a teaching tool. These surveys will contain the same set of physics questions. Tracking changes in those responses quantifies what students learned while playing the game. Preliminary data seems very promising, though the sample size is still too small to draw conclusions.

# Poster Presentations

## Engineering

423

**Student Authors (s):** Jin, Daniel; North Carolina School of Science And Math

**Mentors (s):** Michael Dickey; North Carolina State University

### **Smart Capacitive Touch Screen**

Capacitive sensing technologies are used in many electronic devices, including computer trackpads and touch screens. Conventional capacitive touch screens use an XY grid of electrodes to determine the location of a touch via the change in capacitance of the electrodes. This grid arrangement requires careful patterning of the electrodes and requires a total of  $X + Y$  electrodes. In this project, I used machine learning to design a new type of capacitive sensor that can cut down on the number of electrodes. The approach reached an accuracy of 99.67% while reducing the number of electrodes by 50% in a prototype. These findings open up new routes for the fabrication of capacitive touch screens.

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**Student Authors (s):** Kumar, Akshat; North Carolina School of Science And Math

**Mentors (s):** Gopalarathnam, Ashok; North Carolina State University

### **Flight Analysis During Extreme Weather Phenomenon**

Analyzing flight paths for modern airliners give vast insights into the mechanics behind which one of the greatest sources of trade and transportation occurs in the world. Finding the inefficiencies behind this lifeline can enable the next innovation in the space to further increase both air travel's efficiency and speed. From 2012 to 2017, 62.26% of civil aviation accidents were as a result of turbulence and severe weather incidents. Severe weather events occurring at Atlanta Hartsfield International Airport (ICAO code: KATL) and surrounding airports such as Raleigh-Durham International Airport (ICAO code: KRDU) alone account for \$6 million dollars in cost annually. As such, finding ways to avoid the trouble of severe weather helps reduce the overall cost of air travel and keeps passengers safer. In order to find these inefficiencies, the collection, processing, analysis, and simulation of data is necessary to best define the inefficiencies present in air transport. Adding the final step of simulation is able to combine previous research into an effective algorithm to provide a full stack of data analysis and optimization for flight paths. Thus far, the research has clearly demonstrated that many airliner flight paths oftentimes stray from the path necessary for the most efficient travel during severe weather events. Using flight path simulations and further data analysis, methods of reducing these inefficiencies may be uncovered, assisting the airline industry streamline their severe weather response by correctly predicting the severity and cost associated with any given flight or severe weather event.

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**Student Authors (s):** Zhang, Renee; North Carolina School of Science And Math

**Mentors (s):** Xu, Feng; North Carolina State University

#### **Transfer Learning to Improve Subject-Specific Prosthetic Use**

Surface electromyography (sEMG) is a low-cost, non-invasive type of neural-machine interface that is often used as a mechanism for controlling prosthesis. Typically, sEMG signals are processed to determine a user's intended motions and recognize their gestures. Various deep learning algorithms like convolutional neural networks have been utilized to analyze sEMG signals with greater accuracy than conventional pattern recognition algorithms. However, these approaches are limited because they require data to come from the same feature space and follow similar probability distributions. Since sEMG signals are already highly stochastic, data from different subjects or recording sessions can have high variance, and classification done by these algorithms is difficult to apply across subjects or studies. The goal of this study was to apply transfer learning to increase the subject-specific classification performance of a neural network. Data was collected through an 8x20 HD sEMG electrode array placed on each subject's forearm and force was measured by load cells placed on the index, middle, and ring fingers. Eight subjects were asked to follow a predefined force target to exert various levels of force over a period of five minutes. The collected data was first processed using the mean square value before being visualized into a heatmap to demonstrate the differences in sEMG activation areas between specific fingers. Future work for this study will include using the heatmap images as inputs to a convolutional neural net along with transfer learning to determine if subject-specific performance can be improved.

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**Student Authors (s):** Martinez, Natalie; Sessoms, Olivia; East Carolina University

**Mentors (s):** Bell, Natasha; East Carolina University

#### **Enhanced Nitrogen Removal from Wastewater Effluent using Hybrid Constructed Wetlands**

Nitrogen loading to coastal waterways has been associated with the formation of harmful algal blooms and fish kills. In the face of more stringent effluent regulatory limits for total nitrogen (TN), wastewater treatment plants (WWTPs) must consider sustainable cost-effective approaches to reduce TN in treated wastewater. This project investigates the potential to utilize hybrid constructed wetlands (CWs) -which consist of vertical subsurface flow (SSF) and horizontal SSF cells in series- with woodchip bioreactors as a post-treatment option at WWTPs to further reduce effluent TN loads. Three treatment train designs were investigated, each consisting of four 15-liter treatment cells in series and differing only by the first cell type: (1) Bioreactor, (2) Horizontal SSF CW, and (3) Vertical SSF CW. Cells 2-4 of each design type were Horizontal SSF CW, Vertical SSF CW, and Bioreactor, respectively. Each SSF CW cell consisted of gravel, except the first cell of Designs 2 and 3, which consisted of a 50% gravel and 50% woodchip mix. Treated municipal wastewater was continuously pumped through the treatment trains for 10 weeks at a target 6-hour hydraulic retention time for each cell. Influent and pooled effluent samples were collected weekly. Preliminary results (pending analysis of organic N) indicate that ammonium-N effluent concentrations increased as compared to average influent concentration of 0.02 mg/L for all treatments, with the highest increase observed from Design 3 (0.08 mg/L increase). Nitrate-N/nitrite-N concentrations decreased from an average influent concentration of 0.5 mg/L to <0.1 mg/L for all treatment designs, likely due to denitrification.

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**Student Authors (s):** Sessoms, Olivia; East Carolina University

**Mentors (s):** Vahdati, Ali; East Carolina University

**Biohydrochemical Computational Modeling of Nitrogen Species Transport at Lake Mattamuskeet Waterfowl Impoundments**

Managing the nitrogen cycle is one of the 14 Grand Challenges for Engineering in the 21st Century; addressing nitrogen pollution is critical, as it directly affects water, soil, and air quality. To minimize pollution risks, it is important to be able to predict nitrogen contributions from various contamination sources. This can be done through quantitative simulation of the transformation and transport of nitrogen species in soil zones and aquifers. This project details the development of a model in COMSOL Multiphysics for nitrogen species transport in variably saturated soil at waterfowl impoundments at Lake Mattamuskeet. Lake Mattamuskeet is the largest natural lake in North Carolina and center of the Mattamuskeet National Wildlife Refuge. The lake's managed wetlands are habitat to large amounts of migratory bird populations, and nutrients from these impoundments have been hypothesized to contribute to nutrient pollution of the lake. COMSOL Multiphysics was selected as the program enables simulation of coupled physics designs and creation of exportable, easy-to-use apps. This model simulates the effects of low, medium, and high levels of nitrogen sources -such as bird feces transport, agricultural runoff, impoundment drawdown (in which water and nutrients are removed and sent downstream), and atmospheric deposition- to the production and transformation of nitrogenous compounds in the soil. This model will be validated with an existing, fully integrated model as well as nitrogen processing data in the literature from this site and will provide valuable information towards improving nitrogen management processes.

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**Student Authors (s):** Wilson, Nia; Turo, Diego; East Carolina University

**Mentors (s):** Ryan, Teresa; East Carolina University

**Characterization of vertical temperature gradient variability in the lower atmospheric boundary layer**

This work is part of a larger project developing a numerical model of long-range (~3 km) atmospheric acoustic propagation. Specifically, the focus is on a littoral or riverine environment with a near-shore acoustic source and on-shore receivers. Transmission loss is a measure of how much sound energy is lost as a function of distance. Existing transmission loss models use assumptions about the vertical sound speed gradient and the vertical temperature gradient to calculate the transmission loss. Both the sound speed gradient and the temperature gradient are a function of elevation. Temperature data is collected with the use of iMet-XQ2 sensors mounted on an unmanned aerial vehicle. This work presents a collection of measurements to show the variability in the temperature gradient. Ultimately, vertical measured profiles will then be used to create models of the sound speed profiles as a result of temperature changes in elevation to gain a better understanding of how temperature gradient affect the amount of transmission loss.

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**Student Authors (s):** Wheeler, Mackenzie; East Carolina University

**Mentors (s):** Oyen, Michelle; East Carolina University

#### **Mechanical Failure of Human Fetal Membrane Tissues in Premature Birth**

More than 1 in 10 babies in the U.S. were born premature in 2017, resulting in approximately 4,000 preterm deaths. The goal of this project is to determine the force it takes for a baby's amniotic sac to rupture, then engineer a biomimetic fibrous gel composite that can be used to patch up the rupture site. This gel-like substance will allow the baby more time inside their mother, as this is essential for the baby's life. The amniotic sac is the protective layer that surrounds the fetus and holds the amniotic fluid during gestation. The amniotic sac membranes are being obtained from full-term placentas as the IRB has been approved for acquisition of tissue samples in collaboration with the obstetricians at Brody School of Medicine and Vidant Health. The mechanical properties of the amniotic sac are being assessed with biaxial puncture testing. Specimens are gripped between two 3D printed holders that we designed and printed in the lab that have open centers to allow ample room for puncture testing to occur. The elastic modulus and failure strength of the specimens will be calculated from mechanical testing. Once the mechanical properties of the membranes are obtained, artificial biomimetic membranes will be electrospun and mechanically tested to analyze their compatibility to amniotic sac membranes.

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**Student Authors (s):** Werner, Jack; Leone, Nicolas; North Carolina State University

**Mentors (s):** McConnell, Brandon ; Lawrence, Brandon; North Carolina State University

#### **US Army Performance Analytics**

The US Army National Training Center (NTC) could benefit from the use of real-time data analytics to improve the operational effectiveness of its military training operations through an enhanced After Action Review (AAR). NTC captures Global Positioning System (GPS) data from various sensors during 14-day training rotations that include battle simulations and a live-fire exercise. In this study, we seek to model operational effectiveness for offensive and defensive operations at NTC by identifying and evaluating key measures of performance. Analyzing this data will permit automated models to allow rotating units to more effectively understand their operational effectiveness, identify key areas of improvement, and implement those changes. The data analysis is being performed in R, with the future possibility of creating a real-time interactive dashboard. In order to analyze operational effectiveness, we first create quantitative metrics based on US Army doctrine relevant to NTC operational problem sets. The performance measurements serve as predictors in a regression model to predict operational effectiveness. By conducting real-time data analysis, NTC can improve its ability to provide excellent feedback to rotating units, which will produce much more effective training.

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**Student Authors (s):** Van Dreel, Gabriel; UNC Charlotte

**Mentors (s):** Conrad, Jim; UNC Charlotte

#### **Adding Sensor Peripherals to a ROS Enabled All-Terrain Vehicle**

An All-Terrain Vehicle (ATV) may be utilized for the purpose of emergency response or exploration in areas that may be dangerous for human operators or that in some way would benefit from a remote or absent operator such as supply delivery or navigation. One potential cost-effective solution for designing an ATV that reliably operates in these circumstances may be to perform a modification of an existing ATV. Since 2009, past work has been completed at the University of North Carolina at Charlotte to implement and test the viability of an autonomous ATV design modification with a Honda TRX420FE 2009 ATV. The design modifications included the implementation of autonomously controlled actuators, a locomotion control structure, and individual sensor systems. In the current phase of this autonomous ATV design, a navigation system consisting of a fused Global Positioning System (GPS) and Inertial Navigation System (INS) was integrated with a combined steering, throttle, and braking system over a Controller Area Network (CAN) bus. This control system consists of multiple Microcontroller Units (MCUs) as nodes in a distributed computing network that could be programmed to follow navigation waypoints toward a destination. The transmission of data from an Inertial Measurement Unit (IMU) node and a GPS node to a brain node was implemented for one to multiple waypoints. Complete sensor integration testing with the ATV was not performed but, it is expected that the ATV will perform steering compensation in a stationary test and will sequentially navigate toward programmed waypoints in a full function test.

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**Student Authors (s):** Soker, Ori; North Carolina State University

**Mentors (s):** San Miguel, Adriana; North Carolina State University

#### **Automated Analysis of *C. elegans* Thrashing Behavior using MATLAB**

High-throughput studies using the model organism *C. elegans* allow for rapid data acquisition on critical biological processes. The insights gathered from these studies are increasingly relevant to human health, aging, and neurodegeneration. While several softwares have been developed to track groups of *C. elegans*, it is often necessary to write programs for a specific context because of variations in experimental conditions. This study investigated the use of image processing functions in MATLAB to analyze and quantify thrashing in recorded videos of worms. Each video contained 63 worms from a particular strain in a 7 x 9 arrangement of wells, with one worm per well. Six strains were characterized in seven videos, as one strain was recorded twice. The MATLAB program written for the study counted thrashes for 404 worms out of a total of 441 that were captured on video. Program-calculated thrash counts were verified by comparison to manual counts for eight to nine worms per video. The automated and manual thrash counts differed by less than 10% for over 80% of the worms that were randomly chosen for manual counting. In total, it took the program approximately 30 minutes to count thrashes for all videos and generate strain-specific histograms containing the distribution of thrashes per minute, whereas manual counting for all the videos would have taken over seven hours. Automated data analysis using MATLAB will enable investigation into the relationship between worm movement and neural structure — specifically, the number and size of connections between neurons.

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**Student Authors (s):** Smith, Madeline; North Carolina School of Science And Math

**Mentors (s):** Vargas, Luis; North Carolina State University; UNC Chapel Hill

#### **Arm Attachment for Prosthetic Hand**

This project was focused on designing and modeling in CAD software a device that could attach a prosthetic hand to an able bodied user. The attachment will allow able bodied individuals to participate in tests and experiments using the prosthetic hand. It is important that able bodied users be able to use the hand for tests because it is challenging to find a large group of amputees to test the prosthetic. The goal of this project was to create a comfortable and functional design to securely attach a prosthetic hand to an individual's arm. To make the design comfortable the edges were filleted and the weight was kept as low as possible. Making the design functional included making it adjustable for different arm lengths and widths, reducing the surface area of the arm covered, securing the prosthetic hand to the design, and ensuring that the user's hand could not accidentally interact with the prosthetic. Following the design requirements, a comfortable and functional device was modeled to attach a prosthetic hand to an able bodied user. In the future it would be beneficial to test if the attachment allows able bodied users to complete tests with similar accuracy to amputees using the same prosthetic hand and to ensure that it is comfortable and practical for a user.

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**Student Authors (s):** Sachan, Andrew; Wake Technical Community College

**Mentors (s):** Narayan, Roger; North Carolina State University

#### **Matrix assisted pulsed laser evaporation for layer-by-layer processing of coatings**

Matrix assisted pulsed laser evaporation has many advantages over spin coating, dip coating, Langmuir-Blodgett dip coating for processing coatings containing drugs and other biological materials. The thickness of the coating can be well controlled using the matrix assisted pulsed laser evaporation method. The matrix assisted pulsed laser evaporation method also enables coatings with low roughness to be obtained. In addition, matrix assisted pulsed laser evaporation does not heat biological molecules. In this study, matrix assisted pulsed laser evaporation was used to deposit coatings of the antiproliferative drug rapamycin on glass. We used Alamar Blue and Pico Green studies to study the viability and proliferation of L929 mouse fibroblast cells, respectively. The cells on the rapamycin coatings showed 70.6% viability ( $p=0.0097$ ) and 53.7% proliferation ( $p=0.0120$ ) compared to the borosilicate glass control, respectively [1]. This result shows that the coatings grown by matrix assisted pulsed laser evaporation were able to successfully reduce cell viability and proliferation.

[1] Cristescu R, Negut I, Visan AI, Nguyen AK, Sachan A, Goering PL, Chrisey DB, Narayan RJ. Matrix-Assisted Pulsed laser Evaporation-deposited Rapamycin Thin Films Maintain Antiproliferative Activity. *International Journal of Bioprinting*. 2020;6(1). doi: 10.18063/ijb.v6i1.188

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**Student Authors (s): Richards, Megan; Duke University**

**Mentors (s): Skerrett, Erica; Duke University**

### **Development of a Speculum-Free Liquid Applicator for At-Home Cervical Cancer Screening**

Although cervical cancer can be prevented, over 50,000 people are diagnosed each year, and WHO estimates 88% of invasive cervical cancers occur in low and middle income countries (LMICs). Screening access barriers, stigma, and uncomfortable experiences with the speculum create gaps in screening access and contribute to disproportionate mortality rates in LMICs. To address barriers to cervical cancer screening and discomfort caused by the speculum, the Center For Global Women's Health Technologies previously developed the Callascope, a speculum replacement for self-imaging of the cervix. Using the Callascope for cervical cancer screening requires the application of a contrast agent to highlight potentially cancerous lesions. Typically, this contrast agent is applied with a large cotton swab by a physician, but the Callascope's small channel, designed for comfort and the ability to self-insert, has prevented easy and thorough application. Therefore, to expand the diagnostic capabilities of the Callascope, we designed a compatible liquid atomizer that stains the entire cervical epithelium without the use of a speculum. The atomizer achieves 100% coverage with just 0.5ml of contrast agent, preventing pooling in the vaginal canal that has previously obstructed view of the cervix and inhibited screening. Future steps will include testing the atomizer in volunteers for ease of self-application, as opposed to physician-performed studies.

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**Student Authors (s): Nicholas, Olivia; North Carolina A&T State University**

**Mentors (s): Ferguson, Alesia; North Carolina A&T State University**

### **Strategies and Recommendations to Improve Online Teaching and Education during the COVID-19**

#### **Pandemic**

The World Health Organization declared the coronavirus a pandemic in March 2020, causing Universities to abruptly discontinue or alter in person events and the nature of classroom instruction. Students were given short timelines to relocate homes and both faculty and students had to readjust to teaching and learning remotely. To ensure continuous quality in education, faculty utilized various formats in their classrooms to teach asynchronously, synchronously, or hybrid. From a faculty perspective, these methods were accompanied with some difficulties for students, such as student discomfort, apprehension of the nature of the class, and struggle with workload. We interviewed 32 university faculty research participants across 6 universities in the United States using a survey assessment of 10 questions regarding their experiences, observations, and reactions during their transition to various formats of teaching. Interviews were transcribed to look for common themes across faculty experiences. The purpose of this poster presentation is to specifically present faculty experiences during the COVID-19 pandemic in the spring semester in terms of strategies and recommendations to improve or manage online teaching and learning experiences. For example, maintaining effective communication and interactivity with students, attending faculty workshops and training for online teaching, and better course organization were some strategies identified by faculty. There is uncertainty of how long this pandemic will last and there may be much to gain from the pioneers of teaching through a pandemic for the semesters to come, and for future pandemics. This work is supported through NSF Rapid COVID-19 Grant Mechanism.

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**Student Authors (s):** Middleton, Shea; East Carolina University

**Mentors (s):** Vahdati, Ali; East Carolina University

**The Effect of Inhomogeneous Material Properties in Computational Modeling of Soft and Hard Palate Mechanics in Obstructive Sleep Apnea**

Understanding the mechanical behavior of the soft palate and its surrounding anatomical structures is important to understand the pathomechanics of obstructive sleep apnea. Computational models that assume that the soft palate is homogeneous in its stiffness and simplify the attachment to the hard palate as a fixed support are often utilized to investigate soft palate behavior. The objective of this study is to determine whether including inhomogeneous mechanical properties of the hard and soft palate can change predicted mechanical behavior using computational models. MRI data were imported into Mimics 23.0 to segment the hard and soft palate tissues and to split them into regions with different mechanical properties. Volume meshes of these regions were exported to ANSYS 2019 R3, and uniform pressure was applied to the top of the soft palate while the attachment regions of the hard palate remained fixed. Simulations were then run to compare the mechanical behavior of the homogenous and inhomogeneous models. Results showed that including the heterogeneous mechanical properties of the soft palate caused a significant difference in the predicted displacement compared to the homogenous model. Pressure that produces deformation in the soft palate does not create significant deformation in the hard palate even with inhomogeneous material properties. This study highlighted the importance of including inhomogeneous material properties in structural simulations of the soft palate. Additionally, results show that treating the hard palate as homogeneous or even rigid may not significantly impact predicted uvula displacement.

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**Student Authors (s):** McCoy, Tyler; Elizabeth City State University

**Mentors (s):** Eslami, Akbar; Elizabeth City State University

**Structural Analysis with SolidWorks Simulation Software**

In this project, the design optimization technique is used to increase performance and improve sustainability of three structures that are subjected to constraints. Optimization is the process of maximizing or minimizing an objective function with several design parameters/variables. A very common application of a structural optimization problem arises in finding minimal weight design with constraints. A small reduction of mass can result in substantial savings for the company. Minimizing weight of a vehicle or spacecraft can impact fuel efficiency, increase the payload and performance of the structures. In this study, the SolidWorks simulation software, a Finite Element Analysis (FEA) based software, is used to numerically calculate optimal values of design variables for three structures. All structural designs including three dimensional models are built and simulated by SolidWorks software to yield optimal values. Practical cases are presented to demonstrate the feasibility and validity of the optimum solutions and optimal design. It is shown that an optimization technique has the potential to improve the overall design.

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**Student Authors (s):** McConnell, Sarah; North Carolina State University

**Mentors (s):** Ivy, Julie; North Carolina State University

### **Impact of Hurricane Florence on the Food Bank of Central and Eastern North Carolina**

The poster documents the operational challenges encountered by the Food Bank of Central and Eastern North Carolina, FBCENC, before, during, and after Hurricane Florence. Specifically, the intent is to analyze Food Bank distribution data to quantify the extent of these disruptive events in order to provide insight on how nonprofit food distribution organizations can prepare for, respond to, and recover from disruptions to their network. Food Bank networks are unique in that normal operations involve responding to another type of disaster, hunger need, which is considered slow onset. However, given a sudden onset disaster, they simultaneously must meet the existing hunger need within their service area while responding to the needs of the population in the affected area. This is particularly complicated if the affected area lies within their service area, which can bring increased demand given transportation network and capacity uncertainty.

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**Student Authors (s):** James, Jeremiah; DeRose, Lucci; East Carolina University

**Mentors (s):** Oyen, Michelle; East Carolina University

### **Predicting Controlled Drug Release from Hydrogels**

Typical drug dosing by oral or injection routes leads to drug concentration variations that are inefficient. Hydrogels are used to obtain a controlled drug release, delivering a drug at a constant rate within the effective concentration bounds. Hydrogels were fabricated at 2, 3, and 4% weight agar. Silica nanoparticles were added at 0.5, 1, 4% to affect the release kinetics of the hydrogel. To avoid particles settling due to gravity during the gelation process a roller was created using Lego Mindstorms, keeping the gels in constant rotation. After the gels formed they were soaked in albumin, the model drug of choice, for one week. Drug loaded gels were then moved to saline solution, incubated at body temperature and samples of the saline were collected at set time intervals over one week. A colorimetric Pierce BCA Protein Assay kit was used with a plate reader to measure protein elution profiles from the gels. Indentation tests were used to measure mechanical properties (elastic modulus, viscoelasticity, and intrinsic permeability) of the drug-loaded gels. Data shows a change in mechanical properties with adjustments to the polymer mass fraction, while elution profiles are affected by nanoparticle concentration. Correlation between the diffusion of water and drug through a pressure gradient (indentation testing) versus a concentration gradient (elution tests) is desired. In theory, hydrogel mechanical properties are related to the underlying material structure, offering a fast screening mechanism for the prediction of drug release profiles.

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**Student Authors (s):** Harmon, Alexis; Robertson, Darnell; Elizabeth City State University

**Mentors (s):** Adedeji, Adetayo; Elizabeth City State University

#### **Optical Characteristics of TaSiN Thin Film for Transparent Optoelectronic Devices**

Amorphous TaSiN is a well-known oxidation and diffusion barrier layer for microelectronic devices fabricated to operate in harsh environments. TaSiN is traditionally used as part of the metallization scheme to shield contacts and interconnects from extreme environments and inter-layer diffusion. In this project, we studied the transparency of the material in the wavelength range of 200 nm – 1700 nm for possible applications on transparent optoelectronic devices as a passive protective layer. The barrier layer was deposited on different substrates by magnetron sputtering technique. Pure TaSi<sub>2</sub> target was sputtered in argon and nitrogen gas mixture at room temperature. The deposition pressure and radiofrequency power are 10 and 100 W respectively. The amount of nitrogen content in the layer was varied by changing the percent flow rate of nitrogen in the sputtering gas. The transmittance and reflectance spectra were measured simultaneously. The atomic percent of nitrogen in each layer was determined with Energy Dispersive x-ray Spectroscopy. The percentage increase of nitrogen relative to the reference sample deposited in pure argon gas was calculated. More than 75 % of transmittance was observed for samples deposited with 8% or more nitrogen in the sputtering gas mixture. As an optically transparent and passive diffusion and oxidation barrier layer, TaSiN will be an effective protective layer on transparent optical devices.

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**Student Authors (s):** Cobb, Faith; East Carolina University

**Mentors (s):** Ryan, Teresa; East Carolina University

#### **Tidal variability in soil moisture content near the swash zone on sandy shores**

This work presents an effort to understand and characterize the role moisture content plays in how sound interacts with sand on the beach. This work is part of a larger project developing a numerical model of long-range (~3 km) atmospheric acoustic propagation in littoral or riverine environments with a near-shore acoustic source and on-shore receivers. Previous experiments have studied the effects of moisture content of sand samples taken from various distances from the water's edge of a man-made lake with an artificial beach. This work seeks to perform the same studies in natural coastal areas by recording moisture content in situ via a moisture probe at several depths. Samples will be collected at various distances from the shoreline at both high and low tides. The results collected at the natural coastal areas will be compared to those obtained from studies at the artificial lake in order to inform a related effort that seeks to capture the acoustic characteristics of the sandy beach for use in numerical modeling.

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**Student Authors (s):** Zieg, Parker; East Carolina University

**Mentors (s):** Liu, Yang; East Carolina University

#### **Development of a 4-D Blast Wave Measurement System**

The impact of explosives has been of great interest to the world for a long time. Developing a sounder understanding of how they propagate and interact with structures would result in a greater understanding of how to reduce their impact, saving countless dollars and lives. While there are very few blast wave simulators of desired caliber in existence, the unique Advanced Blast Wave Simulator at East Carolina University will be utilized to further develop an understanding of blast wave behavior. In order to study the complex flow-structure interactions induced by blast waves, a 4D measurement system is required that can quantify not only the three-dimensional flow field behind blast waves, but also the surface deformations of structures interacting with the blast waves. This system will consist of two parts: a particle imaging velocimetry (PIV) system and a digital image projection (DIP) system. By combining the two measurement systems, the blast waves within the system can be fully characterized. In addition, Schlieren imaging will also be conducted for the visualization of the flow field resulting from a blast. A measurement system such as this will allow for future studies relating to blast wave interactions as well as blast wave mitigation.

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**Student Authors (s):** Terry, Chaz; Pope, John; Elizabeth City State University

**Mentors (s):** Asthana, Chandra; Elizabeth City State University

#### **A Novel Six Degrees-of-Freedom Test Platform for a Multirotor Unmanned Aerial Vehicle**

Unmanned Aircraft vehicles (UAVs) have become a vital part of many industries and their use is growing rapidly across many civil application domains. Hand in hand with the rapid development and increasing number of new UAV implementations and applications, UAV testing has gained increased importance. Different testing solutions have been proposed in the scientific literature, focusing on the tests of the UAV as a whole system or its specific components and systems, including multiple UAVs. UAV testing can involve even new challenges. A good example is the drone testing in the field, wherein the environment is not entirely controllable. The environmental conditions are not repeatable, numerous, and very different from each other. On the other hand, a suitable platform inside laboratory, can provide a safe and controlled environment for the performance test of UAVs. Such a test platform is designed in UAS Lab at ECSU to check the six Degrees of Freedom (6 DOF) motion performance of a multirotor UAV. The unique feature of this design is that it does not require six actuators used in other expensive platforms reported in literature. It has, instead, three rings gimballed, as in a gyroscopic arrangement, to offer 3 degree-of-freedom in angular motion. The whole arrangement is then suspended by cord going over pulleys to give freedom in three linear directions. Thus, the complete test setup gives 6 DOF motion in a limited range of linear motion depending on the length of the suspension cord. This is a work-in-progress and will be completed by the end of fall 2020 semester.

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**Student Authors (s):** Paul, Elliot; East Carolina University

**Mentors (s):** Vahdati, Ali; East Carolina University

**A Computationally Efficient Workflow to Predict Subject-Specific Risk of Tibial Fracture**

Tibial stress injuries are common in young people, military trainees, and athletes and are a significant impairment in physical activity. The purpose of this study was to develop a workflow for estimating bone failure probability by combining a probabilistic bone failure algorithm with the 2D open-source software tool VA-BATTS. VA-BATTS was used to calculate the stress caused by the forces and moments applied to the tibia during normal walking. A MATLAB (MathWorks Inc, MA) script was developed based on a probabilistic bone failure prediction algorithm. After image segmentation and stress analysis, the output from VA-BATTS was used as the input to the developed MATLAB script to estimate the probability of failure of the tibial shaft over a given loading period. Cumulative probability of failure with and without repair and adaptation were calculated using published Weibull equations. This workflow can provide helpful insight into a specific subject's bone fatigue life. The results showed higher probability of failure when the tibia was subjected to more cycles of loading per day. Our results show that combining the 2D computer program VA-BATTS with a failure probability algorithm can provide valuable insights into bone fatigue life with minimal computational cost.

## Poster Presentations

### Environmental Sciences

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**Student Authors (s):** Paudel, Apurba; North Carolina School of Science And Math

**Mentors (s):** Castillo, Karl; UNC Chapel Hill

**Historical impacts of tropical storms on skeletal growth of the Caribbean coral *Siderastrea siderea* on the Florida Keys Reef Tract**

Natural and anthropogenic environmental stressors are increasingly impacting marine ecosystems including coral reefs. Tropical storms cause physical damage to coral reefs, and reef storm impacts will continue to increase in the future. Recent studies reveal that climate change and related ocean warming will likely to lead to bigger and stronger storms which will have even greater impacts on tropical reefs. Here, we investigate the impact of tropical storms on the skeletal growth of the reef-building coral *Siderastrea siderea* on the Florida Keys Reef Tract over the past century. We examined relationships between storm variables such as radius, windspeed, and distance of the storm from the coral collection site with skeletal growth parameters of density, extension, and calcification over 20 years. Additionally, relationships between a smaller subset of storm variables and coral growth parameters were assessed over 125 years. Coral growth in years with storms were compared with that of growth in years without storms. Our results reveal that while storm distance, radius, and windspeed significantly impacted coral growth, sea level pressure and angle of the storm no effect on coral growth. Although further research is needed, understanding the effects of acute disturbances such as tropical storms on coral reefs could help better predict future climate change impacts on coral reefs.

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**Student Authors (s):** Peterson, Johnny; UNC Charlotte

**Mentors (s):** Gagne, Sara; UNC Charlotte

#### **A Genetic Analysis of Urban River Otter Food Webs**

Urban environments represent a dynamic natural community of native and newly introduced species that continually change with anthropogenic inputs and climatic variables. Food web models demonstrate the ecological connectance of species by examining trophic structure and the flow of energy from primary producers up through apex predators and back. This ongoing research, conducted in Mecklenburg County, North Carolina, focuses on four groups of otters with varying levels of urbanization. Each site utilizes passive infrared trail-camera monitoring and routine field visits aimed at the collection of fecal samples for genetic processing. Recent advances in gene sequencing technology present the ability to decipher component species to the microbial level found within each fecal sample, in a process known as environmental metabarcoding. With this highly detailed information, food webs can be generated with much higher accuracy than theoretical models and with greater frequency than post-mortem gut content analyses. These models are then digitally rendered, chronologically arranged, and animated to show trophic ecology over time, offering a unique perspective of species interaction. In an era of increasing globalization with quickly shifting ecosystems, novel approaches to simplify our understanding of underlying ecological mechanisms becomes essential.

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**Student Authors (s):** Blackshear, Aalayza; UNC Pembroke

**Mentors (s):** Rock, Amber; UNC Pembroke

#### **Examining the effects of an agricultural and urban area on water quality and benthic macroinvertebrate diversity in the Lumbee River**

Runoff from human-impacted areas can pollute nearby rivers, decrease water quality, and be harmful to aquatic organisms. Nitrogen and phosphorus runoff are common in agricultural areas, and urban areas can be a source of contaminants to nearby rivers. Water quality in the Lumbee River was evaluated at 6 different sites that stretched from the headwaters to near the South Carolina border. The first three sites (Chalk Banks, Recreation Center Rd, and Sampson's Landing) were focused on potential agricultural impacts to the river. Two sites (McNeif's Bridge and High Hill) were focused on potential impacts of an urban area (Lumberton, NC). The last site, Fair Bluff, was used to assess the extent to which the river recovered from agricultural and urban inputs after flowing through a less-impacted area for several miles. The open-source computing program R was used to analyze and graph the collected data. Our data suggest that the Lumbee River is not strongly impacted by agricultural or urban inputs, because all variables we measured indicated little to no change in water quality between sites.

**Student Authors (s):** Haulk, Michael; UNC Charlotte

**Mentors (s):** Gagne, Sara; UNC Charlotte

**A comparison of anuran diversity and habitat attributes between remnant and stormwater ponds in the Charlotte Metropolitan Region**

Freshwater ponds serve different purposes from ecological hotspots to water recharge areas. Stormwater ponds specifically play an important role as human civilization encroaches upon our natural wetland environments. The goal of this research is to show the quality of the environment created by stormwater ponds versus remnant ponds, by comparing their attributes. We surveyed anuran species at 33 remnant and 33 stormwater ponds across the Charlotte Metropolitan Region using surveys in 2014 and 2015. In addition, we measured the following habitat attributes: different types of vegetation, presence of fish, water depth, pH, leaf litter, impervious surface, as well as meteorological data at the time of survey. We tested for significant differences in anuran species richness and habitat attributes between remnant and stormwater ponds using a t-test. On average remnant ponds had more anuran species.

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**Student Authors (s):** Christian, Tyler; UNC Chapel Hill

**Mentors (s):** Castillo, Karl; UNC Chapel Hill

**Impact of winter ocean warming and reduced food availability on calcification rates of the temperate coral *Oculina arbuscula***

Increasing seawater temperatures induced by anthropogenic climate change cause significant stress and drive widespread mortality in a variety of marine organisms. Corals are chief among the species that are directly impacted by these temperature changes. However, recent research has focused primarily on the effects of elevated seawater temperatures on tropical corals, especially during the warmer summer months, leaving significant gaps in our understanding of how temperate corals are affected by climate change. We conducted a common garden experiment to investigate the calcification response of the temperate coral *Oculina arbuscula* under ambient and elevated winter temperatures over 60 days. Additionally, corals were fed either low or normal quantities of newly hatched *Artemia* sp. nauplii to explore whether predicted decreases in plankton availability will impact *O. arbuscula* calcification rates. Our results suggest increased calcification rates under elevated winter temperature and reveal that food availability had little effect on *O. arbuscula* calcification under ambient or elevated winter temperatures, contrasting previous work suggesting that heterotrophy acts as a mitigator of summer thermal stress by assisting the coral host in maintaining positive net calcification rates. These results suggest that warmer winter temperatures could extend the growth interval for this coral species or that *O. arbuscula* could transition to increasing growth during the winter months in response to ocean warming, which has important implications for how temperate corals will respond to future changes in our climate.

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**Student Authors (s):** Yu, Jimin; North Carolina School of Science And Math

**Mentors (s):** Perry, Baker; Appalachian State University

**Long-term Weather Analysis of Watauga County**

As an outdoor activity enthusiast living in the Blue Ridge Mountain region, I noticed that the weather patterns in my hometown (Watauga County, NC) seemed to be different from year to year. I felt that certain winters (especially the more recent ones) were warmer and mostly rainy while others had consistent snow for most days of the season. This led me to be curious about (1) if the changing weather patterns in Watauga county are short-term variability or long-term trends, and (2) if there has been an unusual change in weather patterns, how it affected local businesses. I obtained 90-year weather data (average temperature, snowfall, and precipitation) of Watauga County (station: 310977 and 310982) from the North Carolina State Climate Office. Using Microsoft Excel, anomalies of monthly and yearly average temperature, yearly precipitation, and yearly snowfall were calculated and analyzed with an average of 1929 through 2000 as a baseline. An email interview was conducted with local farmers to receive their opinion on changing weather patterns, the impact it may have had on their businesses, and how they have adapted to the changes (if any). The findings suggest that in the 21st century, average annual temperatures have mostly been cooler than the baseline, and snowfall has been having a decreasing contribution to total precipitation.

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**Student Authors (s):** White, Cambria; North Carolina Central University

**Mentors (s):** Yang, Zhiming; North Carolina Central University

**Exploring AOD-PM2.5 Correlation for PM2.5 Monitoring**

The objective of this project is to analyze the correlation between PM2.5 (Particulate Matter) data obtained from AirNow and AOD (Aerosol Optical Depth) data obtained from NASA. The goal of the project is to determine whether AOD data could be used as an alternative to estimate PM2.5 concentration in areas that do not have local PM2.5 measuring stations. The process includes obtaining AOD data from the MODIS Terra satellite on NASA's website and PM2.5 data (hourly and daily) from AirNow and then joining both the sets of data and geographical locations of the PM2.5 stations using GIS and Excel. After the joined data sets are created, the correlations of both the hourly and daily PM2.5 are calculated in Excel. The correlations are then analyzed to identify a) if the AOD data correlates with PM2.5 and b) if hourly or daily PM2.5 measurements are more consistent with AOD data. It was found that the AOD data did correlate with PM2.5 data and that the daily PM2.5 data had a better correlation with the AOD data. It was also found that the spring and summer months had better correlations than winter months.

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**Student Authors (s):** Sanchez de Armijo, Lelani; Elizabeth City State University

**Mentors (s):** Kupietz, Kevin; Elizabeth City State University

**Hazard and Risk Assessment: Elizabeth City, NC**

This is an Emergency Management study that provides a hazard and risk assessment analysis of certain hazards affecting the town of Elizabeth City, NC. The research takes a holistic approach to natural and man-made hazards that have affected the city in past and recent years, causing significant losses in Pasquotank County. For this assessment, the city's demographic information and history of hazards have been considered to predict future events. With this research, we will propose possible solutions to help minimize the risks of the vulnerable and potentially affected population.

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**Student Authors (s):** Sadula, Mahita; UNC Charlotte

**Mentors (s):** Byker, Erik; UNC Charlotte

### **Investigating and Comparing Aspects of Sustainable Development Goal #13**

The purpose of my research poster is to investigate and compare aspects of the Sustainable Development Goal (SDG) # 13 Climate Action, which relates to taking urgent action to tackle climate change and its impacts. In particular, I examine the following aspects of SDG # 13: global greenhouse gas emissions and renewable energy. The main research question for my comparative study is: What are the similarities and differences between the United States and Brazil related to the aspects of Sustainable Development Goal #13? For this research presentation, I focus on comparisons between the United States and Brazil. To conduct this research, I used a literature review research design methodology. I searched for resources on the UNC Charlotte J. Murrey Atkins Library databases using keywords like Brazil, climate change, Paris Agreement, SDG 13, and the United States. The data for the literature review consisted of five international reports, three journal articles, two statistical databases related to climate change, and eight other reliable sources. The findings of my research reveal that both countries rely heavily on the consumption of fossil fuels, however, the United States ranks second globally in terms of installed capacity of renewable energy, whereas Brazil ranks third. Under the Paris Agreement, the United States, a major contributor to global emissions, promised to reduce emissions by 2025. Similarly, Brazil pledged to reduce greenhouse gas emissions by eliminating illegal deforestation in the Amazon by 2030. The research poster includes an examination of the challenges and possibilities in meeting SDG # 13 Climate Action.

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**Student Authors (s):** Plumley, Alison; North Carolina State University

**Mentors (s):** Leggett, Zakiya; North Carolina State University

### **Evaluating the Impacts of Organic Matter Removal on Soil Nutrients in a Loblolly Pine (*Pinus taeda*) Plantation**

A forest ecosystem supports a natural flux of organic matter inputs and outputs, immensely affecting its biological and nutrient properties. Soil organisms use organic matter as food, ingest them, and mix them with the minerals in the soil, breaking down the organic matter in a form that may once again be used by plants. The Pamlico Organic Matter Study was established in 2006 to evaluate organic matter removal and addition in a loblolly pine (*Pinus taeda*) plantation. This study was conducted in the lower Coastal Plain of NC and consisted of thirty plots established in a randomized complete block design following the clearcut of a 33-year-old loblolly pine stand. The study consists of three treatments: a control treatment with no organic matter manipulation, a removed treatment where all the organic matter and harvest residuals were removed, and a doubled treatment where those materials removed from the previous treatment were applied. Data were collected by analyzing soil samples taken at three depths, 0-12.5cm, 12.5-25cm, and 25-37.5cm. Findings revealed no significant differences between soil organic matter, carbon, nitrogen, or calcium. The values for soil organic matter, soil carbon, soil nitrogen and soil calcium ranged between 0.7-3%, 0.2-4%, 0.02-0.2%, 14-43% respectively. These findings suggest that this forest is resilient to the impacts it was subjected to by the addition and removal of organic matter.

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**Student Authors (s): Parrish, Robert; Alford, Wanya; North Carolina State University**

**Mentors (s): Richmond-Bryant, Jennifer; North Carolina State University**

### **Which US Census Division has the Most Energy Efficient Homes?**

This study aims to determine the US Census Division that has the most energy-efficient homes, based on data from the Energy Information Administration's (EIA) Residential Energy Consumption Survey (RECS), using a calculated variable that measures the average thousand British Thermal Unit (BTU) per square foot. The data was analyzed in R-Studio where it was described by its mean, standard deviation, and spread. It was split up by the 10 US Census Regions and within those regions was further divided into three different levels of home insulation; well, adequately, and poorly. The data was visualized as histograms, box plots, and a bar plot. It was put through one sample t-test's that ultimately brought this study to its conclusion, by producing p-values that allowed the hypotheses to be judged. It was determined that the South Atlantic US Census Division had the most energy-efficient homes (with an average thousand BTU per square foot of 34.54), however, the Pacific Census Division was so close (with an average thousand BTU per square foot of 34.61) that further research is suggested to determine if there is a difference between the two.

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**Student Authors (s): McNaught, Jillian; North Carolina School of Science And Math**

**Mentors (s): Grieshop, Andrew; North Carolina State University**

### **Comparing Satellite and Surface Ambient Air Pollutant Concentration Data in Rural Malawi**

The low-income countries of Sub-Saharan Africa are known to be greatly affected by air pollution, but largely lack air quality monitoring networks. To understand and potentially reduce global air pollution, reliable air quality data must be made available. To meet this goal, The Grieshop Atmosphere and Environment Lab at North Carolina State University deployed 3 'ARIsense' v1.0 solar-powered sensor packages (Aerodyne and QuantAQ, Inc.) to three rural sites in Malawi for ~1 year to measure ambient gas and particulate pollutant concentrations and record meteorological data (i.e., temperature, wind speed/direction, relative humidity). From this dataset, we analyze carbon monoxide and PM<sub>2.5</sub> (particulate matter with an aerodynamic diameter < 2.5 micrometers) concentration data using openair software in R to characterize regional, seasonal, and diurnal pollutant trends, along with prevailing wind patterns. Further, we compare NASA Fire Information for Resource Management System (FIRMS) and NASA Giovanni Satellite observations to the surface-level measurements from Malawi. Surface-level measurements indicate an increase in pollutant concentrations during September, October, and November, periods of prevalent agricultural burning. FIRMS data confirm a large number of fires in and around Malawi, while satellite observations support the surface-level findings of increased pollutant concentrations during these months. Comparisons to these external data sources improve confidence in the moderate-cost surface measurements, furthering our goal to provide a reliable baseline of ambient air quality conditions around the Malawi sites.

**Student Authors (s):** Lim, Prisca; UNC Chapel Hill

**Mentors (s):** Marchetti, Adrian; UNC Chapel Hill

### **Investigation of Phytoplankton Composition and Primary Productivity in the Galápagos Islands**

The Galápagos Islands are habitat to some of the most unique organisms on the planet. The distinctive seasonality and high biodiversity of the islands and surrounding ocean waters are largely attributed to the convergence of major ocean currents in the area. Notably, the Humboldt current and the Cromwell current upwell at the Galápagos Islands, providing nutrient-rich waters to the ocean surface. These nutrients sustain the phytoplankton community which in turn promotes high productivity and biodiversity within the Galápagos Marine Reserve (GMR). Phytoplankton are important because they constitute the base of the marine food web and are key producers of oxygen. As such, alterations to the microbial diversity will affect the rest of the marine ecosystem. In order to predict changes throughout the marine ecosystem, we must first understand what factors cause variability in phytoplankton composition and primary productivity. With that aim in mind, in collaboration with the Galápagos Science Center, we measured physical and chemical properties using CTD casts and collected water samples to determine the concentration and composition of phytoplankton across the GMR. DNA extraction and subsequent 18S rRNA gene sequencing were performed to observe how phytoplankton composition varied throughout the GMR. This project aims to determine whether variations in physical and chemical parameters correlate with variations in biological measurements. Accordingly, we may identify if a certain set of environmental conditions encourage the proliferation of certain phytoplankton. This information will help us predict future changes in our marine ecosystems and guide the conservation and management of the GMR

**Student Authors (s):** Kremer, Ellie; Nice, Naomi; Meckler, Karli; Townsend, Luke; UNC Chapel Hill

**Mentors (s):** Hall, Nathan; UNC Chapel Hill

### **Quantifying the Effectiveness of Wetland Restoration in a Tidally Dominated System**

Coastal wetlands provide valuable ecosystem services such as water quality improvement, carbon burial, and habitat creation. However, there has been a significant decline in wetland area as development and sea level rise threaten coastal habitats. Coastal wetland creation and restoration projects have been implemented to preserve these ecosystem services. We evaluated the effectiveness of the wetland restoration methods used at the North Carolina Coastal Federation's North River Wetland Preserve (NRWP), Carteret County, NC. The NRWP converted 6,000 acres of farmland into wetlands beginning in 1999. We used a chronosequence of three wetland restoration sites at the NRWP to evaluate how habitat quality (expressed as invertebrate abundance and diversity), denitrification rates, and carbon burial change over time. Additionally, we assessed water quality changes by comparing loads of nutrients, pathogenic bacteria, and fecal indicator bacteria from the restored wetland versus adjacent farmland, the wetland's previous state. Significant differences in hydroperiods among sites confounded our ability to assess change over time and likely drove variation in habitat quality, carbon burial, and vegetation cover. Similarly-high denitrification rates ( $\sim 700 \mu\text{M}/\text{m}^2/\text{hr}$ ) were found across restored and natural wetland sites. Higher concentrations of *Vibrio* spp. and lower concentrations of *E. coli* were observed in farmland outfalls than wetland outfalls. Results presented here provide insight for future methods of restoration that optimize the provision of ecosystem services.

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**Student Authors (s): Campos, James; UNC Pembroke**

**Mentors (s): Madan, Maharjan; UNC Pembroke**

**An attempt to unveil aquifer response to glaciations using residential water-well data from glaciated and unglaciated regions in Ohio**

Groundwater flows through interconnected pores and hence the occurrence and rate of groundwater movement depend upon aquifer parameters, storativity and transmissivity. External stresses such as tectonics and glaciation can influence the aquifer parameters. The scopes of this research were to i) study the variations in hydraulic conductivity of the bedrock due to cyclic loading and unloading, ii) compare the hydraulic conductivity of an aquifer under glaciated and non-glaciated regions, and iii) later relate the thickness of glaciers to the aquifer yield. We assumed that glacial loading and unloading developed secondary porosity in the bedrock aquifers due to changes in principal stress conditions. Thus, we hypothesized that glaciated region would have higher hydraulic conductivity than unglaciated regions and the thicker glacial drift would correlate with higher aquifer yield. To test these hypotheses, we chose two counties in the state of Ohio, one along the maximum glacial extent and another north of it. Data obtained from ODNR consists of well location, well construction details, well production test, and rudimentary lithologic descriptions. The results suggested that glacial loading and unloading had significantly impacted bedrock aquifers resulted in higher yield in glaciated areas than in unglaciated areas. Within the glaciated regions, the thicker the glacier drift, the higher the aquifer yield. Such findings are important to anyone interested in withdrawing high volume of groundwater regularly. Besides the local scale, it could also give insights into how bedrock would respond to the change in stress conditions due to glacier melting in context to global warming.

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**Student Authors (s): Bishop, Marisa; UNC Chapel Hill**

**Mentors (s): Johnson, Evan; UNC Chapel Hill**

**Renewable Energy in North Carolina**

The North Carolina Department of Environmental Quality, Division of Air Quality (NCDEQ-DAQ) wanted to know what the changes to air quality and public health are with differing energy sources. We analyzed the benefits for different potential energy policies to empower the DEQ-DAQ to make informed energy policy decisions. We concluded that reducing coal operations in NC produced the most significant changes in oxides of nitrogen, sulfur oxide, carbon dioxide, and fine particulate matter emissions present in our atmosphere. To assess health and environmental benefits related to energy policy, we conducted data analyses using the Environmental Protection Agency's data modeling tools, AVOIDed Emissions and geneRation Tool (AVERT) and CO-Benefits Risk Assessment (COBRA). We found that: 1. Energy policies combining increases in natural gas and energy efficient and renewable energy production yields the largest reduction in emissions without sacrificing electricity generation, per our AVERT analysis. 2. Reducing coal generation correlates to increased economic health benefits, less work-loss days, and a reduced mortality rate. 3. Estimations of the social cost of carbon can be inexact and inconsistent, but can provide the helpful information to measure the effects of carbon emissions on climate change and health benefits. 4. New York has quantified health benefits by the number of work days lost, heart attacks, and respiratory illnesses that were avoided. Our research did not explore the costs, financial or otherwise, of implementing the energy policies we studied.

**Student Authors (s):** Hill, Michaela; Pasha, Tanvir; Harris, Angela; North Carolina State University

**Mentors (s):** Harris, Angela; North Carolina State University

**Optimization and validation of microbial source tracking of poultry-specific fecal marker LA35 in North Carolina**

Microbial source tracking is an effective tool to determine contamination sources in environmental samples. Commercial poultry operations (CPOs) that contribute to industrial poultry production have increased significantly and there is limited research on the environmental effects of these. This is particularly evident in North Carolina, one of the top poultry producing states in the USA. A poultry-specific DNA marker, referred to as LA35, has been validated in poultry samples from states in the US using quantitative PCR (qPCR) methods, but has not been validated in NC. Droplet digital PCR (ddPCR) has the potential to detect the LA35 at lower concentrations in environmental samples, as compared to qPCR. We developed a ddPCR assay for the LA35 target for the detection of poultry feces in environmental samples. Key reaction parameters of the assay were optimized for the detection of the target. Optimization involved varying the ddPCR cycling parameters including annealing temperatures, annealing times, thermocycler type, and the total number of cycles. This research plans to further validate the assay by testing host (i.e., poultry) and non-host feces (e.g., non-poultry) for detection of the LA35 target. For validation, DNA was extracted from various fecal samples and ddPCR was performed. To evaluate the marker's performance in distinguishing host feces, both sensitivity and specificity were quantified. ddPCR proved effective in validating the LA35 poultry fecal marker in the state of North Carolina by providing accurate quantification of poultry-fecal contamination in environmental samples, and also shows the potential of accurately validating the marker for use.

## Poster Presentations

### Humanities

**Student Authors (s):** Merced, Sophia; High Point University

**Mentors (s):** Ringel, Paul; High Point University

**The Influence of Slave Narratives on Society**

William Wells Brown, who was separated from his family, sold to the highest bidder, whipped to near death, and suffered through the most agonizing time period of American history, wrote a book about his life experiences. His work, *Narrative of William W. Brown, A Fugitive Slave*, provided insight into the horrid institution of slavery, specifically with the treatment of the slaves, and highlights the tremendous hardships they were forced to endure. It revealed to northerners, as well as southerners, the moral and ethical issues of slavery that many did not want to admit existed. Before the book's publication, Americans were willfully unaware of the reality of the treatment of enslaved peoples and were able to convince themselves that slavery was an essential component of the American economy. However, through vivid descriptions of traumatic scenes, such as families being separated and slaves being brutally whipped, Brown was able to emphasize to readers that slavery was horrendous and immoral and that it could no longer be ignored. Brown was pushing the issue to the front of people's minds to prove that there is a problem with society, and it needed to be addressed and fixed. This translates to Brown's main motivation towards writing his narrative: to influence lawmakers into scrutinizing the future and fate of African Americans, along with the moral and ethical problem of slavery. By forcing people to realize the inhumanity of slavery, he is hoping to generate sympathy towards enslaved people in order to influence lawmaking.

**Student Authors (s): Wellener, Ava; North Carolina School of Science And Math**

**Mentors (s): Cantrell, David; North Carolina School of Science And Math**

### **Sundown Towns: Now & Then**

This research project is primarily concerned with the operation of sundown towns, both historical and modern, and how this information relates to the understanding of systemic racism in the United States. Though the knowledge that sundown towns existed is not disputed, the question of how the sundown town-status was maintained has less obvious answers. Thus, one goal of this research is the identification of the specific means through which towns (both historical and modern) exclude African-Americans and uphold white supremacy, primarily through the analysis of historical documents. Identifying which methods are used and assessing the effectiveness of these methods (the methods may include laws, violence, housing discrimination, etc) will shed light on the mechanisms of systemic racism. In addition, this research will seek to compare historical sundown towns with modern or former sundown towns. This comparison is focused on identifying what methods of exclusion changed, what methods fell out of use, and what new methods were developed as sundown towns transitioned to the modern era. The research is focused primarily on the former sundown town of Southern Pines, North Carolina, including West Southern Pines, a historically African-American neighborhood. Preliminary research suggests that even as sundown towns desegregated, systemic racism in these towns continued through a variety of means, and is perpetuated to the modern day. This research will provide a better understanding of the system of racism in sundown towns, connect the present with the not-so-distant past, and challenge the historical racial "progress" narrative.

**Student Authors (s): Mendez-Sandoval, Jovani; Olagbemiro, Neema; Elon University**

**Mentors (s): Monico, Carmen; NCA&T North Carolina A&T State University**

### **The Impact of the COVID-19 pandemic on U.S immigration Detention Centers**

Although the United States has been a major proponent of human and civil right standards internationally and domestically, it has failed to recognize the basic human rights of immigrants in its territories. A review of international convention and national regulations regarding human rights, refugees and asylum seekers was conducted and interviews with immigrant service providers were carried out. Findings include the widespread separation of families at the U.S. border, the incarceration of family units and youth in Immigration and Customs Enforcement (ICE) detention facilities where there is evidence of abuse, the prolonged custody and documented neglect of children under the Office of Refugee Resettlement (ORR), the denial of asylum rights, and the deportation of parents without a reunification plan. Under the COVID-19 pandemic, ICE has increased the spread of those infected by moving those suspected or testing positive from one detention center to another to presumably contain the coronavirus, by keeping minors and their families in custody in spite of judicial orders to release them, and by returning asylum seekers to neighboring nations and their countries of origin even if they are suspected or have tested positive.

**Student Authors (s):** Day, Samantha; Belmont Abbey College

**Mentors (s):** Jensen, Erin; Belmont Abbey College

### **Flannery O'Connor and Her Influence on Both Catholic and Secular Cultures**

Flannery O'Connor's unique niche of Southern Gothic literature is deeply ingrained with aspects of her life. Having grown up in Georgia during the 1920s and 1930s, Flannery lived during a period of constant change and development throughout American History. Her works often portray a lot of religious symbolism, particularly Catholic symbolism. Included in her works are often Christ figures, ill individuals, and individuals of all stereotypes. She liked to write in a satirical manner of the world around her but particularly that of the South. With her works being a reflection of the world around her and of her own nature, they are unique to the world of literature. Gothic literature is a genre that causes people to question the world around them as it causes the world to be put into an unusual light; one that they are not accustomed to. Flannery O'Connor's Southern Gothic nature is no exception to that. Often her work is seen as twisted and repulsive but that only interests people more. Her peculiar works gained popularity in both Catholic and secular communities and largely influenced them. In order to understand her influence on these cultures, we must understand why she writes the way she does and what her intentions are behind it.

## Poster Presentations

### Mathematics & Quantitative Studies

**Student Authors (s):** Koppe, Owen, Jovani; North Carolina School of Science And Math

**Mentors (s):** Jones, Chris; UNC Chapel Hill

### **A Heterogeneous Mixing Epidemic Model with Adaptive Edge Rewiring**

Many epidemic models rely on either a random mixing of individuals or a more complicated network based contact structure. The mean field approximation epidemic model is often an oversimplification but a simulation based network epidemic model can become extremely complex very quickly. In between these two there are moment closure approximation models which approximate network structure using a system of differential equations. Moment closure models quickly become high dimensional and make the model hard to understand and utilize. The Heterogeneous Mixing (HM) model utilizes a system of modified mean-field equations where there is a nonlinear transmission rate,  $kS^pI^q$  where  $k$ ,  $p$ ,  $q$  are fit parameters. We will determine how effective the HM model is at approximating a SIRS network based epidemic model with adaptive edge rewiring on a lattice grid network.

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**Student Authors (s):** Lytle, Aidan; UNC Greensboro

**Mentors (s):** Lewis, Tom; UNC Greensboro

**Topological Data Analysis as a Novel Jet Detection Method in Heavy Ion Collisions**

In Heavy Ion Collisions, a common feature of study is a quality known as the flow, which is represented mathematically by a complex fourier series. To study the flow, we must extract the non-flow from the flow. In this work, we claim that the non-flow is topologically distinct from the flow, and that it can be separated by common methods in Topological Data Analysis (TDA). We implement these algorithms on a large test data set to gauge the utility of the TDA approach. We discuss observations from the simulation and possible future directions.

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**Student Authors (s):** Gutierrez, Isabel; North Carolina Central University

**Mentors (s):** Mulrooney, Timothy; North Carolina Central University

**A Comparison of Travel-Time Distance Calculation Versus Euclidean Distance Calculations as Applied in The Study of Food Deserts**

Through the use of GIS (Geographic Information Systems) one can map food deserts using Euclidean distance or drive-time. Euclidian Distance measures the straight-line distance from the point A to point B and is relatively simple and quick to compute using the distance formula. Drive-time measures how long it takes to get from point A to point B taking into account stops and turns using vehicular transportation. Drive-time measurements require more calculations and data. Drive-time measurements require conversion of GIS data to a network model, as well as attributes that account for speed limits, drive-time and network distance. If both of these measures model proximity to food and food deserts the same way, it reduces the need for these more resource-intensive network calculations. The purpose of this project is to see what extent there is a difference between measures of Euclidian Distance and drive-time in food security analysis since one is more resource-intensive than the other. In order to successfully conduct this research, there will be an assessment of both methods using data collected from Guilford County, North Carolina. There will also be maps and tables created using geostatistics, network calculations, z-score analysis, and the use of the Near function to compare the two.

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**Student Authors (s):** Flors, Ryan; Saniya Sampson; North Carolina State University

**Mentors (s):** Richmond-Bryant, Jennifer; North Carolina State University

**Energy Insecurities in the United States; energy burden vs LIHEAP funding**

To investigate differences among energy burdens (total household annual income / total household annual energy bills), and investigate differences among households eligible for energy assistance programs, compared to the percentage of these that receive financial support. The United States has been broken down into 6 separate regions, the Atlantic, the Midwest, the Mountain, the Northeast, the Pacific and the South. The average energy burden per state, as well as the average energy burden per region have been calculated, and plotted. The same has also been done to calculate the average state eligible percent of households receiving assistance, and the region percentages. F-tests, were conducted for the two variables, between the six regions in order to identify if there are any such differences, worth testing for. Once those came back, that there are differences, we conducted multiple Tukey's Honest Significance Tests, to identify the statistically significant differences between regions. The results came back, that in terms of energy burdens across the six regions, the Atlantic region was significantly different than 3 other regions, while the Southern region was statistically significantly different than 4 other regions. There were no other significant differences between the regions of interest, based on our dataset analyzed. In terms of the eligible percent of households receiving financial assistance based on the region of the household, the Pacific region was statistically significantly different than 2 other regions, while the Northeast region, proved to be statistically significantly different than 2 other regions as well.

## Poster Presentations

### Medical & Health Sciences

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**Student Authors (s):** Powers, Katelynn; Campbell University

**Mentors (s):** Christie, Sarah; Campbell University

**Vitamin D Deficiency and Its Relation to Immune Function**

The Vitamin D deficiency pandemic has increased the world population's susceptibility to many diseases due to the role Vitamin D plays in the body's immune system. Vitamin D is a modulator of the immune system, meaning that it influences immune system responses by regulating actions of cells, especially T cells, in the immune system as well as metabolizing enzymes made and activated by immune system cells. Levels of Vitamin D in the body vary by season, due to the varying exposure to sunlight throughout the year, but consumption levels of Vitamin D through other sources, such as food or beverages, are still not adequate for the recommended daily value for the body. Focusing on the nutrition of the body and ingesting foods that contain Vitamin D that are primarily consumed, one can look at how the levels of Vitamin D in the body correlate with a decreased time span of infection, or even resistance to types of infectious diseases. By investigating what foods are lacking in the average human diet that can lead to this deficiency and their levels of Vitamin D that can be digested by the body, how the deficiency impacts the immune system can be analyzed by looking at the vitamin's role in the immune system and its responses. This will help emphasize different aspects of nutrition that can be improved to not only boost Vitamin D levels in the body, but also improve overall immune function and bodily health.

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**Student Authors (s): Watkins, Sarah; Duke University**

**Mentors (s): Clements III, Dennis; Duke University**

**Prenatal Health Differences between First-time and Experienced Mothers? Attending Clinica Esperanza in Roatan, Honduras**

Through a remote partnership with the on-site OBGYN and nurses at Clinica Esperanza, my project team conducted remote surveys (n=200) with pregnant mothers in Roatan, Honduras to understand regional, age, and biological trends in prenatal health. We analyzed the data to find any differences between first-time mothers and experienced mothers (mothers who have already had children). Mothers participating in the survey had a mean age of 24.85 years, with 41.5% (83/200) of the participants as first-time mothers. We found that of the 200 mothers, 184 had considered Clinica Esperanza as an option for birth, though 183 claimed they would be birthing at the local hospital. 38% (76/200) of the mothers surveyed were there for their first prenatal checkup, with weeks along in their pregnancy averaging at 17.304, while first-time mothers averaged higher at 18.913 weeks. 90.36% (75/83) of the first-time mothers and 86.32% (101/117) of experienced mothers were taking prenatal vitamins, 77% (154/200) of whom were receiving these vitamins from Clinica Esperanza. Most birth defects and miscarriages occur in the first trimester, so the average first-time mother coming in for her first prenatal checkup when she is well into her second trimester creates a point of concern for the clinic. There is additional work needed to analyze statistical significance of any data differences, and a geographic display of prenatal data to visualize geographic differences in prenatal health markers is underway to assist in planning for community-based educational interventions.

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**Student Authors (s): Peel, Meghan; Tang, Linda; Duke University**

**Mentors (s): Huchko, Megan; Duke University**

**Understanding the effects of COVID-19 on access to family planning services through big data platforms**

In the field of sexual and reproductive health behavior research, data traditionally comes from sources such as surveys and census information that is only accessible to researchers long after respondents have participated in the research. However, in recent years, social media and internet search data, often called “big data”, has evolved as a new and rapidly expanding field with the potential to predict and analyze human behavior quickly and accurately. With the increasing reliance on the internet and virtual setting due to the COVID-19 pandemic, internet searches and social media sites have become a powerful tool for accessing healthcare information and services. Our research uses big data to examine changes in access to contraceptives and other family planning services during COVID-19. We utilize data from two main sources: Twitter and Google Trends. Through a strategic succession of search queries analyzed in short and long term contexts, we compare and contrast the strength of results from each source and what information it provides about family planning use. Though both data sources are equally accessible, the similarities and differences presented in this research will determine whether either data source can be used as a valid measure of family planning services and whether one is more accurate and reliable than the other. It will also create a more complete understanding of if and how individuals are accessing family planning services in the time of the COVID-19 pandemic.

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**Student Authors (s):** McCarthy, Katelyn; Hines, Daniel; Schneible, Jennifer; Bullock, Garrett;

**Elon University**

**Mentors (s):** Christopher, Shefali; **Elon University**

### **The Effect of Menopause and Overuse Injuries on Athletic Identity in Female Masters Runners**

**Purpose:** Female master runners (FMR) may have unique considerations regarding personal athletic identity, considering physiological changes of menopause and overuse injury. Identifying influences on FMR athletic identity can improve rehabilitation by providing insight into limiting factors of performance and assisting clinicians in referring appropriate psychosocial intervention. The purpose of this study was to investigate the relationship between 1) FMR athletic identity and menopause, and 2) FMR athletic identity and injury. **Methods:** FMR age 35+, not currently pregnant or 3 years postpartum, completed an online questionnaire on athletic identity (AIMS), Oslo Sports Trauma Research Center Overuse Injury Questionnaire (OSTRC), and menopause status. Analyses of covariance assessed relationships between AIMS, overuse injury, and menopause. Models were adjusted for age, BMI, injury history, weekly running mileage, running event, and competitive status. **Results:** 143 FMR (age:  $55.5 \pm 7.9$ ; BMI:  $22.9 \pm 3.0$ ; weekly mileage:  $21 \pm 13.0$ ; injury history prevalence: 57%; menopause prevalence: 20%) participated. Mean AIMS score was  $39.5 \pm 10.1$ , OSTRC 0 (0, 11), and 24% sustained an overuse injury. No relationship was observed between menopause and AIMS (2.1 (95% CI: -3.3, 7.4),  $p = 0.453$ ). FMR with current overuse injury reported decreased AIMS scores ( $-4.1$  (95% CI: -7.6, -0.5),  $p = 0.026$ ) compared to uninjured FMR. **Conclusion:** No relationship was observed between menopause and athletic identity; however, FMR with an overuse injury demonstrated decreased AIMS scores compared to FMR without. There is no current minimum clinical importance difference to interpret AIMS score decreases. Future research is needed to assess psychosocial influences on recovery and resiliency in FMR.

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**Student Authors (s):** St Arnauld, Kiara; **East Carolina University**

**Mentors (s):** Smith, Aimee; **East Carolina University**

### **Perceptions of Healthcare among Adolescents and Young Adults with Epilepsy**

About 1.2% of the United States population has active epilepsy, with approximately 470,000 children affected. As a recurrent medical condition, epilepsy requires consistent medical care from a neurological specialist, meaning these children must eventually transition from pediatric to adult providers for their epilepsy care. One barrier to transitioning to adult epilepsy care is the negative perception youth and their parents have about adult neurology providers (e.g. less time spent, compassion/sensitivity, and communication with the patient). This fear and inconsistency surrounding transition in healthcare create cascading problems including non-adherence to medications and lack of independence in self-managing their condition, as responsibility remains on caregivers (Payne, et al., 2005; Holbein, et al., 2018). This study aims to explore perceptions of care quality in pediatric and adult neurological care for adolescents and young adults with epilepsy and their caregivers. Data was acquired from five youth and two caregivers through quantitative (questionnaires) and three youth and five caregivers through qualitative (focus group discussions) methods. Questionnaires asked about time spent with their health care provider, provider focus during appointments, and perceived quality of healthcare (questions from the "Parent's Perceptions of Quality Care" communication subscale). This study provides preliminary evidence that, despite negative perceptions of adult care from pediatric patients, adult patients do not experience a decline in the quality of healthcare post-transition. Information from this study may allow a more comprehensive understanding of the barriers to healthcare transition in epilepsy and could be utilized in the development of interventions to improve healthcare transition in epilepsy.

**Student Authors (s): Vitsupakorn, Shawin; Duke University**

**Mentors (s): Yamey, Gavin; Duke University**

**Early experiences of Pradhan Mantri Jan Arogya Yojana (PM-JAY) in India: A narrative review**

Over 60% of India's population had no form of health insurance in 2018. Vulnerable populations – families living in poverty and urban slums, or individuals working outside of the formal sector – continue to fall through the cracks. The country's high out-of-pocket expenditure (OOPE) has only driven households (HHs) further into poverty: in 2011, 17.3% of India's HHs spent more than 10% of their total HH budget on health, and 4.2% were pressed below the poverty line. In 2018, the Government of India initiated Pradhan Mantri-Jan Arogya Yojana (PM-JAY). The scheme aims to cover the bottom 40% of the country's poor and vulnerable populations, equating to 107.4 million households. Our research evaluated the progress of PM-JAY toward universal health coverage (UHC) and identified gaps in population coverage, service coverage, and financial risk protection. Although PM-JAY marks a momentous step toward UHC for India, our narrative review suggests that the scheme has failed to reach all populations in poverty. The quality of care, healthcare fragmentation, and OOPE remain key areas of concern. Our analysis of insurance claims further shows that disparities in health infrastructure and service utilization persist across state borders. To accelerate UHC in India, it is time to extend benefits to out-patient care, support health technology assessment, enforce national standards for hospitals, and ramp up the government's role in capacity-building.

**Student Authors (s): Syed, Ayesha; Smani, Shayan; Duke University**

**Mentors (s): Berger, Miles; Duke University**

**The MARBLE Study: Modulating ApoE signaling to Reduce Brain inflammation, deLirium, and postoperative cognitive dysfunction**

**Background:** Of the 16 million adults aged 60 and above undergoing surgery each year, it is expected that 40% will suffer from Postoperative Cognitive Dysfunction (POCD) and delirium. Currently two mechanisms are thought to explain the high risk of POCD: neuroinflammation and exacerbation of pre-existing Alzheimer's Disease pathology. The ApoE4 allele of the ApoE gene is implicated in both. **Design:** This RCT escalating dose phase II clinical trial looks to examine the safety, feasibility, and efficacy of CN-105, an ApoE4 mimetic peptide that aims to block ApoE receptor activation. Participants are non-cardiac, non-neurologic surgery patients aged  $\geq 60$  years (N=201). **Methods:** Patients receive CN-105 or placebo intravenously every  $6 \pm 1.5$  hours up to 13 doses or discharge starting 1 hour before surgery. Neurocognitive testing is conducted prior to and six weeks after surgery. Daily postoperative delirium screening is conducted for 5 days or until discharge. 32 channel EEG is employed to detect intraoperative markers of POCD and/or neuroinflammation. Blood and cerebrospinal fluid (CSF) samples are collected before surgery and 24 hours and 6 weeks after surgery. Blood samples are obtained for complete blood count with differentials and serum analysis. CSF samples are obtained to measure levels of tau, phospho-tau, amyloid beta, and inflammatory cytokines including IL-6, IL-8, G-CSF, and MCP-1. **Conclusion:** MARBLE provides the potential to evaluate the pharmacogenomic interaction between CN-105 and the various ApoE genotypes. CN-105 is expected to mitigate postoperative neuroinflammation and Alzheimer's Disease pathology changes and to decrease the severity of POCD.

**Student Authors (s):** Smith, Breanne; East Carolina University

**Mentors (s):** McCarlie, Van Wallace; East Carolina University

### **A Systematic Review of Oral Health Literature**

Oral health literacy (OHL) is the measure of how well an individual collects and comprehends oral health information, as well as his or her ability to subsequently make advisable oral health care decisions. Measures for OHL include a number of validated instruments from the literature, such as the Rapid Estimate of Adult Literacy in Medicine and Dentistry (REALMD). Oral health status (OHS) is the measure of one's current state of oral health, based upon clinical examination, evaluation of dental, medical and social histories, including results from and stability of previous treatment. Measures for OHS include metrics such as decayed teeth, missing teeth due to dental caries, and filled tooth surfaces (DMFS or DMFT), periodontal status, and other oral health measures determined through the aforementioned examinations and evaluations. Children may become a casualty to dental neglect due to a caregiver's limited OHL, putatively affecting a child's OHS. Language, socioeconomic status, education, occupation and other factors can all influence both OHL and OHS of parents and their children. This literature review will examine the correlation between parental (guardian) OHL and OHS of their children.

**Student Authors (s):** Sakarvadia, Mansi; Li, Rui; UNC Chapel Hill

**Mentors (s):** Styner, Martin; UNC Chapel Hill

### **Atypical Neonate Extra-axial CSF is Associated with Reduced Cognitive Development at Age 1 and 2**

We aim to assess if enlarged extra-axial cerebrospinal fluid (EA-CSF) volume at neonatal age is associated with a child's performance on the Mullen Scales of Early Learning (MSEL) at 12 and 24 months of age. 3T MRI scans were acquired from 651 infants at neonate age (20.8 $\pm$ 8.9 postnatal days). EA-CSF and global tissue volumes were computed via a new tool called AutoEACSF1. The MSEL was administered to these infants at 12 and 24 months, measuring ability in gross motor and four domains that comprise an overall cognitive composite score: fine motor, visual reception, receptive language, expressive language. General linear models including intracranial cavity volume, gestational age at birth, maternal education and sex as covariate were employed. The subgroup of infants whose EA-CSF volumes measured in the top 5th percentile (i.e., 2 SDs above the mean; n=33) displayed significant negative correlations between elevated EA-CSF at neonatal age and expressive language (p=0.001) and cognitive composite scores (p=0.016) at 12 months. However, at 24 months of age, these associations were no longer significant. No significant associations were found for subjects with EACSF volumes below the top 10th percentile. This study finds that atypically high levels of EA-CSF volume shortly after birth are associated with lower expressive language and overall cognitive ability at 12 months of age. These results suggest that there may be a pathological threshold of high EA-CSF volume that could serve as an early biomarker of a child's reduced cognitive ability at 12 months.

**Student Authors (s):** Rosenberg, Charli; Campbell University

**Mentors (s):** Jennifer Bunn;

### **Sprint Zone Analysis by Position of Division I Women's Lacrosse**

The purpose of this study was to compare sprint zones by position in Division I women's lacrosse during practice and games. Sprint zones are measured by the number of sprints conducted in zones 1 through 5 (Sprint1-Sprint5) and the distance traveled in each zone (Dist1-Dist5). Zones are determined by percentage of maximum sprint speed (1<60%, 2=60-69%, 3=70-79%, 4=80-89%, 5≥90%). Players (n = 13) wore a vest with microtechnology to track movement and speed during games (n = 9) and practices (n = 41). Players included 4 attackers, 4 midfielders, and 5 defenders. There were no main effect differences between training and games ( $p=0.288$ ), or by an interaction with position ( $p=0.396$ ). Univariate analyses showed differences between training and games for average speed ( $p<0.001$ ), max speed ( $p=0.021$ ), Sprint1 ( $p<0.001$ ), Sprint2 ( $p<0.001$ ), Sprint3 ( $p<0.001$ ), Sprint4 ( $p<0.001$ ), Sprint5 ( $p=0.031$ ), Dist1 ( $p<0.001$ ), Dist2 ( $p<0.001$ ), Dist3 ( $p=0.001$ ), and Dist5 ( $p=0.003$ ). All variables were higher in games than training except Sprint5 and Dist5 where training was higher. For the interaction between activity type and position there was a difference in Sprint4 ( $p=0.032$ ) and Sprint2 ( $p=0.046$ ), with attackers logging higher values during practice in Sprint5 and Dist5. There is a mismatch in sprint demands between training and games, with a greater game demand for efforts in zones 1-4 in games for all positions. These data indicate no need to train differently by position, but coaches and support staff can utilize this information to alter the structure of training to meet the demands of the game.

**Student Authors (s):** Riddick, Monet; Elizabeth City State University

**Mentors (s):** Kaur-Walker, Kulwinder; Elizabeth City State University

### **The Impact of Natural Disasters on Mental Health in a US Rural Population**

Natural disasters have shown to be a prime cause of mental health issues in communities experiencing natural catastrophes, so called disaster mental health. Disaster mental health is defined as a behavioral and mental health preparedness and response directed towards individuals and the community as a whole. The purpose of this study is to explore the relationship between mental health and natural disasters in northeastern North Carolina. I have been collecting data on perceptions and experiences of after-effects of hurricanes amongst northeastern North Carolina communities. The anonymous survey link for the study questionnaire was shared via social media. The participants answered questions about their background, mental health before and after the hurricanes, and natural disaster assistance. So far, the data analysis indicates that 23% males and 77% females responded and more than 50 % indicated mainly receiving food and financial assistance, but not mental health or healthcare assistance; though, 62% were not satisfied with the assistance received. Many of the participants hadn't heard of any programs that assist with mental health issues, and have listed not having enough service providers, issues with insurance/cost, and being unaware of potential services. The responses suggested social stigma as one of the reasons contributing to inaccessibility of available programs. As this study continues, it is expected to have a clearer picture to identify the areas of concern to bring mental health resilience in affected communities in addition to other aspects of life. Keywords: natural disaster, mental health, survey, northeastern North Carolina, hurricane, social stigma

**Student Authors (s):** Potts, Jennifer; North Carolina State University

**Mentors (s):** Cole, Jacque; North Carolina State University

### **Dynamic Cortical Bone Growth is Reduced Following Brachial Plexus Birth Injury**

Brachial plexus birth injury (BPBI), the most common nerve injury in children, causes bone deformities, muscle paralysis, and lifelong arm impairment, often necessitating surgery. While previous studies reported humeral head deformities post-injury, the effects on bone growth and mineralization rates and their involvement in BPBI-related impairments are unknown. Our objective was to determine dynamic humeral bone formation in a rat model of two BPBI presentations. Sprague Dawley rats underwent perinatal neurectomies (n=16 per group): preganglionic injury (mimics nerve avulsion), postganglionic injury (mimics nerve rupture), and sham injury. Bone fluorochrome labels were injected at 10 days (calcein) and 3 days (alizarin) before sacrifice at 8 weeks. Affected and unaffected humeri were dissected, fixed in formalin, embedded in polymethylmethacrylate, sectioned transversely, polished, and imaged. Dynamic cortical bone growth was analyzed across groups (ANOVA with Tukey post-hoc tests) using standard metrics: mineralizing surface per bone surface (MS/BS), mineral apposition rate (MAR), and bone formation rate (BFR/BS). On the periosteal surface, BFR/BS was reduced for preganglionic injury compared to sham (-25.3%,  $p=0.033$ ) and postganglionic (-31.5%,  $p=0.042$ ). The endosteal surface showed lower BFR/BS for postganglionic compared to sham (-27.8%,  $p=0.041$ ). Postganglionic BPBI had reduced endosteal cortical bone formation, while preganglionic BPBI had reduced periosteal cortical bone formation and mineralization. These data suggest bone growth is differentially affected by BPBI type, corresponding to humeral head differences measured previously, and thus could be targeted for more effective treatments.

**Student Authors (s):** Pillutla, Aditya; Mulry, Abigail; Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)

**Mentors (s):** Marsh, Caleb;

### **Projected COVID-19 Impact of Reopening Universities in Fall 2020 Based on Case Studies of 10 Widespread US Universities' Campus Population Numbers**

In the summer of 2020, the United States faces a situation in which schools are forced to weigh the costs and benefits of reopening in fall 2020 while confronted with the COVID-19 pandemic, and to what extent they should do so. We chose to evaluate the risks of reopening by utilizing a simulation to model the effects of introducing one student infected with SARS-CoV-2 (COVID-19) to ten different university campuses in order to predict how the virus would spread amongst the student populations at each one. By developing case studies for each university, we were able to simulate the impacts COVID-19 could have at several different percentages of overall attendance. This representative modeling system helped us better judge the number of students that should be allowed on campus at different sizes of universities. Through our study we determined that for US schools to proceed with in-class instruction, many safety measures, inspired by those successfully taken by other countries, will need to be put in place and enforced strictly. Our modeling demonstrated that larger universities should limit the number of students they allow back on campus, preferably to under 25% of regular attendance to reduce infections and deaths, and all but the smallest schools should not consider bringing more than half of their enrolled students back to campus in the fall. Through our research we were able to predict outcomes of 40 different potential upcoming situations and develop a rough guideline for universities to refer to.

**Student Authors (s):** Osborn, Ramsey; East Carolina University

**Mentors (s):** Vail-Smith, Karen; East Carolina University

### **Components of Sexual Satisfaction As Identified By Emerging Adults**

**Background and Objectives:** Presented are preliminary findings of an examination of the components of sexual satisfaction as identified by college students. Sexuality researchers and educators support the incorporation of the components of desire, pleasure and satisfaction in comprehensive sex education, but most research in this area focuses only on adult populations. The goal of the present research is to examine how sexually-active, heterosexual emerging adults rated the importance of various factors to sexual satisfaction during partnered sexual activity. **Method:** Self-reported, anonymous electronic surveys were administered to a convenience sample of 2151 undergraduate students in a required personal health class. **Results:** The majority of both males and females indicated that all but one of the 27 satisfaction factors presented were “somewhat important” or “important” to their their own satisfaction during partnered sexual activity. Differences between males and females are identified. **Conclusions:** Among emerging adults, positive and satisfying sexual experiences can lay an important foundation for achieving the developmental task of becoming sexually healthy adults. These and findings from further analysis of our data can inform comprehensive sexuality education efforts that effectively incorporate the teaching of satisfaction into sexual health curricula.

**Student Authors (s):** Nolte, Sarah; East Carolina University

**Mentors (s):** Cofie, Leslie; East Carolina University

### **Obesity Prevalence among Veterans by Race/Ethnicity**

Despite evidence of increasing obesity prevalence among the US veteran population, national level estimates of racial/ethnic differences between veteran and non-veterans are limited. We examined the relationship between veteran status and race/ethnicity with obesity, after adjusting for health access factors. We used a National Health Interview Survey data (2013-2017) on adults, aged 20 years and older (N=151,765), were examined. Differences in veteran status by sociodemographic, health-access factors were examined using chi-square and t-test statistics. Multivariate binary logistic regression analysis was used to examine the association between veteran status, race/ethnicity and health access factors with obesity, controlling for sociodemographic factors. We found there was a significant difference in obesity prevalence among veterans (31.11%) and nonveterans populations (29.55%),  $p < .01$ . In a fully adjusted model, veteran status was not associated with obesity. Black (38.10%) and Hispanic (37.34%) veterans had a higher prevalence of obesity compared to White and Asian veterans. Racial differences in obesity was observed for both veterans and non-veterans,  $p < 0.01$ . In stratified analysis, white veterans were more likely to be obese than white nonveterans (AOR: 0.93, CI: 0.87, 0.98). Hispanic veterans (AOR: 1.53, CI: 1.23, 1.90) were more likely to be obese than Hispanic nonveterans. No differences were observed based on veteran status among Blacks and Asians. In conclusion, differences in obesity prevalence by veteran status varied by race/ethnicity, such that whites and Hispanic veterans were more likely to be obese than their nonveteran counterparts. More work is needed to determine additional factors associated racial/ethnic differences in obesity among veterans.

**Student Authors (s):** Nelson, Alyson; UNC Chapel Hill

**Mentors (s):** Smith-Ryan, Abbie; UNC Chapel Hill

#### **Effects of acute feeding on resting metabolic rate and respiratory quotient**

**BACKGROUND:** Acute postprandial changes of substrate utilization and metabolic rate likely impact body composition and fuel utilization. The purpose of this study was to evaluate acute effects of high protein (PRO) vs. high carbohydrate (CHO) intake on resting metabolic rate (RMR) and respiratory quotient (RQ). **METHODS:** In a randomized cross-over design, 38 normal weight young adults (age  $21.9 \pm 3.2$  years; weight  $71.7 \pm 9.9$  kg) completed three separate trials. Visits were randomly ordered and included a high PRO (63.5 g PRO, 58% meal), a high CHO (116.5 g CHO, 86% meal) meal, or a trial after an 8h fast (FAST). For women ( $n=17$ ), all three visits occurred during the mid-follicular phase. Height and weight were collected while fasted. Food was given upon arrival and allowed to digest for 30 minutes. RMR and RQ were collected in a supine position using the indirect calorimetry canopy method for 30 minutes. **RESULTS:** RMR after PRO ( $2224.68 \pm 458.54$  kcals) was significantly greater than CHO ( $2092.11 \pm 376.03$  kcals;  $p < 0.001$ ); both conditions were significantly greater than FAST ( $1798.78 \pm 265.07$  kcals). RQ was significantly greater after CHO ( $0.87 \pm 0.06$  a.u.) compared to FAST ( $0.75 \pm 0.06$  a.u.;  $p < 0.001$ ); with no difference between FAST and PRO ( $0.75 \pm 0.06$  a.u.;  $p = 0.999$ ). There was no significant sex interaction for RMR or RQ ( $p > 0.05$ ). **CONCLUSIONS:** A high PRO meal increased RMR acutely, compared to a high CHO feeding, which may have implications for body re-composition. High PRO does not appear to increase in RQ, suggesting that acute high PRO may support greater thermogenesis and fat oxidation, regardless of sex.

**Student Authors (s):** Nandigama, Nainika; Fennell, Alyssa; East Carolina University

**Mentors (s):** Graber, Ted; East Carolina University

#### **Endurance Training to Improve Functional Status in Older Mice**

One seemingly inevitable consequence of getting older is a progressive loss of physical function and exercise capacity. Ancillary and contributory to this functional decline are the diseases of sarcopenia (age-related loss of muscle mass and strength) and frailty (inability of the body to maintain homeostasis). We know that exercise can help to preserve muscle mass and improve function in older humans. However, we need to develop animal models to study the underlying molecular mechanisms of functional loss, with the hope of uncovering potential therapeutic targets. In this study, we compare mouse functional abilities following four months of individualized endurance training: voluntary wheel running (VWR,  $n=8$ ) or a high intensity interval training (HIIT,  $N=10$ ) mimetic on a treadmill. We hypothesized that both exercises would improve function, but that HIIT would promote more extensive adaptation. For four months, the VWR mice spent 4 days/week with a running wheel (outcome is km/day) and the HIIT group ran 3x/week on a progressively difficult protocol (number of intervals interspersed with a resting active recovery) based upon their maximum treadmill running speed. There was significant improvement in physical function and body composition in both exercise groups, similar to that expected by older adult humans undertaking a similar training protocol. However, the results did not support our hypothesis that HIIT would improve function more than VWR. We conclude that our models will be useful for future mechanistic investigations of the intersection of aging, exercise, and functional decline.

**Student Authors (s):** Murphy, Savannah; East Carolina University

**Mentors (s):** Dias, Nancy; East Carolina University

### **Long-Term Physical Health Outcomes of Bereaved Parents**

**Purpose:** The purpose of this study is to identify bereaved parents' long-term physical health outcomes, including sleep, Body Mass Index (BMI) and changes in health risk behaviors such as smoking and drinking alcohol. **Background and Significance:** A child's death is one of the most traumatic events an individual can experience. Individuals who experience it are more likely to have adverse health outcomes including increased morbidity and mortality. There is little evidence of long-term health outcomes of bereaved parents in the United States. It is important to study bereaved parents' health outcomes to plan parental bereavement care. **Methods and Analysis:** This study used a cross-sectional, survey design to assess bereaved parent's health whose child (0- <19 years) had died within the past 10 years. A convenience sampling technique was used to enroll participants using the decedent database from a tertiary care hospital. Questionnaires were sent to eligible parents using a secured database (REDCap). Questionnaires included a demographic data survey and a survey to assess sleep disturbance (PROMIS\_Sleep). The demographic survey included assessment of history of past illness (e.g. diabetes or hypertension) and change in smoking and alcohol intake. Participants indicated their overall health perception on a visual scale of 0 to 100. **Findings:** Preliminary analysis identified sleep disturbances (83%) with 6% reporting more than 1 SD worse than normative data. Sleep disturbance was significantly associated with increased alcohol use since the child's death ( $F=8.0$ ;  $p=0.006$ ). Participants (20%) reported initiating or increasing tobacco or alcohol use after their child's death.

**Student Authors (s):** Mistreanu, Andrei; North Carolina School of Science And Math

**Mentors (s):** Graves, Lee; UNC Chapel Hill

### **Effectiveness of ONC201 vs. TR-57 on the Cellular Metabolism**

Our goal was to determine which metabolic pathways in cancer cells were affected by our imipridones. Imipridones are a class of anti-cancer molecules that target the metabolisms of the cancer cells. By interrupting many vital metabolic pathways within the cell, imipridones inhibit cancer cell growth and replication. Therefore, we sought to identify how the metabolites within the pathways were affected by the treatment we were researching. By knowing the affected pathways and metabolites, we could better understand the biochemical mechanisms involved. With this information, a superior imipridone could be created on the basis of which pathways it affects. The design goal of this research was to determine the pathways involved, whether they were upregulated or downregulated, and by how much the amount of the associated metabolites differed after treatment. After obtaining peak mass data from in-lab mass spectroscopy, the online resource MetaboAnalyst was used to find pathway significance, orientation, and metabolite fold change. From our first experiment, we found that at 48 hours, the 15 most significant pathways all showed a down-regulated, or reduced, production. The most significant pathways were generally those involved in maintenance and reproduction. Therefore, we concluded that both drugs being tested, ONC201 and TR-57, down-regulate major pathways vital to the cell. Moreover, the metabolites involved in these pathways are also decreased. This finding supports the observations made of the anti-cancer properties of the drugs at the cellular level.

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**Student Authors (s):** McFarlane, Tori; UNC Chapel Hill

**Mentors (s):** Hursting, Stephen; UNC Chapel Hill

**Metaboendocrine and Inflammatory Correlates of Tumor Growth Following Caloric Restriction and Vertical Sleeve Gastrectomy in a Mouse Model of Breast Cancer**

Breast cancer is the second leading cause of cancer-related deaths in women in the United States. Furthermore, obesity – a disease that burdens more than 40% of American adults – is a well-established risk factor for breast cancer. Research from our laboratory has demonstrated that weight loss from dietary calorie restriction reduces mammary tumor growth to a greater extent than bariatric surgery in obese mice. Therefore, this project sought to compare circulating cytokine and metaboendocrine hormone levels between these dietary and surgical weight loss groups to identify plasma markers potentially contributing to differential tumor mass outcomes. Control mice were maintained on a low-fat diet while all other mice were placed on a high-fat diet to promote obesity. Following 15 weeks on diet, mice either received bariatric surgery or a sham surgery. Post-surgery, bariatric surgery mice received a low-fat diet while sham surgery mice either continued to receive a low-fat diet (normal weight control group), high-fat diet (diet-induced obese control group), or were 30% calorie restricted in either a chronic (CCR) or an intermittent fashion (ICR). Plasma cytokines, hormones, and fasted blood glucose levels were analyzed. Interestingly, of 10 metaboendocrine hormones and 30 cytokines tested, only fasted blood glucose, PAI-1, and CXCL 13 were significantly lower in both CCR and ICR mice compared to bariatric surgery mice. Therefore, these data suggest that decreased circulating PAI-1 and CXCL 13 and/or decreased fasted blood glucose may contribute to the superior antitumor effects of calorie restriction versus bariatric surgery.

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**Student Authors (s):** Lu, Joy; Duke University

**Mentors (s):** Schultz, Thomas; Duke University

**The Effects of Environmentally Persistent Compounds GenX and PFOA on Human Health**

Per- and polyfluoroalkyl substances (PFAS) are a ubiquitous group of man-made chemicals used in food packaging and nonstick products such as Teflon. PFAS are a threat to human, animal, and environmental health because they are environmentally persistent, bioaccumulative, and carcinogenic. Shorter chain PFAS such as GenX have been synthesized as an alternative aimed to reduce toxicity and replace current PFAS such as perfluorooctanoic acid (PFOA). Many PFAS have been shown to negatively impact human health and affect the liver, kidneys, reproductive organs, and developmental processes. The combination of inadequate data on the effects of GenX on human health and drinking water contamination in Eastern North Carolina has encouraged additional research into the potential effects of GenX exposure. Four cell lines (HepG2, HK2, NIH3T3, and NIH3T3L1) were exposed to varying concentrations of PFOA or GenX, and cell viability assays were performed to identify candidate cell lines and dosages. HepG2, human liver cancer cell line, was chosen for further analysis, and preliminary cell culture data shows that the toxicity of PFOA is higher than that of GenX, although there may be underlying mechanisms affecting cells exposed to PFAS that may not be observed during cell culture. Ongoing studies utilize novel techniques, including RNA sequencing, bioinformatics, and a phosphoprotein array, to identify and analyze the biological mechanisms and signaling pathways that result in toxicity of the cell. This project will help to identify crucial mechanistic differences between the effects of PFOA and GenX and shape our understanding of how GenX affects human health.

**Student Authors (s):** Kritzer, Isabella; North Carolina School of Science And Math

**Mentors (s):** Coombs, Catherine; UNC Chapel Hill

**Exploration of trends in survival and therapy-related myeloid neoplasms among patients with chronic lymphocytic leukemia in pre- and post- novel agent eras**

Chronic lymphocytic leukemia (CLL) is a form of blood cancer that arises in B lymphocytes which accumulate in the blood and bone marrow and is the most common form of leukemia in adults. Until newer therapies were introduced, cytotoxic chemotherapy was used to treat CLL but was extremely toxic causing 6%<sup>1</sup> of patients to develop therapy-related myeloid neoplasms (tMN) with a 9.6-month<sup>2</sup> median survival. Newer targeted therapies, such as ibrutinib and venetoclax, block specific enzymes that led to the progression of CLL. We are trying to determine if the prevalence of tMN has declined since the introduction of targeted therapy since they're proven to be less toxic for the patient. We will analyze patients with CLL using the SEER database to determine if the prevalence of tMN has declined since newer therapies have been introduced. The Surveillance, Epidemiology, and End Results (SEER) program collects cancer statistics covering 34.6% of the United States and is run by the National Institute of Health. The SEER database includes data from 1975-2017. Since the anticipated latency for the development of a tMN is 35-42 months following the receipt of fludarabine-containing chemotherapy, it's unlikely that the full impact of the paradigm shift from cytotoxic chemotherapy to targeted oral therapies will be seen. We're still analyzing the data so are unable to gather a final answer to our research question but this research has great potential to be further researched when the SEER database releases new data every fall.

**Student Authors (s):** Kellogg, Camryn; UNC Chapel Hill

**Mentors (s):** Tilley, Stephen; UNC Chapel Hill

**BPIFA1 in asthmatic airway epithelia: reduced concentrations and down-regulated expression**

Based on previous studies involving airway protein bactericidal/permeability-increasing protein fold-containing family member A1 (BPIFA1), it is clear that BPIFA1 plays a key role in reducing eosinophilic airway inflammation, relaxing airway smooth muscle, and defending against microbial infection. To interrogate a potential relationship between BPIFA1 and asthma, this study set out to measure BPIFA1 concentrations and expression levels in asthmatics. Using ELISA from bronchoalveolar lavage (BAL) supernatants, BPIFA1 concentrations were measured from twenty mild asthmatics and twenty normal volunteers. All forty volunteers participated in research bronchoscopy at our center. The results demonstrated a significantly lower BPIFA1 concentration in BAL samples from asthmatics compared to normal volunteers (9 + 3 vs. 38 + 8 ng/mL,  $p < 0.005$ ). The reduced BPIFA1 levels in asthmatics remained independent of gender, asthma control medication, and atopic status. We then set out to explore BPIFA1 gene expression in asthmatics, and conducted an analysis of seven transcriptomic studies involving 355 asthmatics and 193 controls (Tsai et al. ERJ. 2018;51). Through bronchial brushings, all seven studies measured BPIFA1 expression levels in airway epithelia. Our meta-analysis revealed a consistent down-regulation of BPIFA1 expression in asthmatic subjects compared to normal volunteers. The reduction in BPIFA1 expression was both statistically significant ( $p = 2.3 \times 10^{-3}$ ) and of large effect (-0.5). Ultimately, these findings together suggest that down-regulation of expression is responsible for the reduced levels of BPIFA1 protein in asthmatics, not degradation. Further research of BPIFA1 levels in asthmatics with well-defined phenotypes is required to help determine if BPIFA1-deficiency contributes to the pathogenesis of asthma.

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**Student Authors (s):** Jackson, Megan; Campbell University

**Mentors (s):** Christie, Sarah; Campbell University

**The Need for Evidence Based Practice Throughout the Continuum of Patient Care A Case Study: Meniscal Injury in An Active Law Enforcement Officer**

A 52-year-old, male, law enforcement officer was involved in a head on collision with a vehicle that was fleeing from police custody. The officer complained of severe left leg pain and was transported to the emergency room. He was evaluated with non-life-threatening injuries, given conservative medical intervention and referred to an orthopedic specialist. The patient sought the care of an orthopedic specialist and was diagnosed with a deep bone bruise. He was instructed to continue conservative medical management and return to full active duty in seven days. Continued knee pain led the patient to see another specialist who examine the left knee and ordered a magnetic resonance imaging (MRI). The MRI revealed an oblique undersurface tear of the posterior horn of the meniscus. The orthopedic specialist injected a corticosteroid into the joint and stated the meniscus would most likely heal on its own. The injection relieved the pain by reducing inflammation in the joint. He was cleared to return to full active duty as a law enforcement officer with no limitations or restrictions. However, the patient is concerned; he experiences pain in job required activities, such as kneeling. The differing diagnosis's and continuum of care is of concern. Evidence based practice (EBP) is important because it aims to provide the most effect care. EBP incorporates best reach evidence, clinical expertise and patient values and preferences. EBP is needed to improve health care quality, reduce medical errors, balance known benefits and risks, and help integrate patient preferences into decision-making.

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**Student Authors (s):** Hartman, Mackenzie; East Carolina University

**Mentors (s):** McNeill, Charleen; East Carolina University

**Emergency Preparedness Education Inclusive of Chronic Disease and Access and Functional Needs**

The number of disasters is increasing worldwide and the level of knowledge of and preparation for such disasters may be inadequate, particularly among vulnerable populations. Emergency preparedness education by health care providers can be effective in improving preparedness of people with increased medical needs. The purpose of this project was to: 1) determine what evidence exists in the literature regarding emergency preparedness levels of vulnerable populations, 2) determine what evidence exists in the literature regarding the effect of healthcare provider education on emergency preparedness levels of vulnerable populations, 3) examine what education methods and other tools can be utilized to easily deliver emergency preparedness education by health care providers to vulnerable populations, and 4) develop evidence-based emergency preparedness education deliverable to various populations. The first three objectives were completed via an extensive literature review using PubMed and CINAHL. Information was gathered on current disaster preparedness measures used in the U.S., the impact of disasters on vulnerable populations, and evidence-based recommendations for disaster preparedness and education. The last objective was accomplished by using various sources found throughout the literature review as well as additional resources that provided guidance on creating effective education. The resulting education tool is the first disaster education course ground in evidence and not merely expert opinion. This education tool was created to be inclusive of vulnerable populations, modifiable for various locations, and, ideally, motivating of behavioral change in the realm of disaster preparation.

**Student Authors (s):** Gnanavel, Sreya; Wu, Jackie; Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)

**Mentors (s):** Thomas, Kelsey; Auburn University

**Association between biomass use and COPD in developing countries: Review of existing evidence and possible solutions**

Chronic obstructive pulmonary disease (COPD) is a chronic disease that affects the lungs. Research suggests that COPD is caused by inhaling toxic fumes, and most studies have focused on the role of cigarette smoke and outdoor pollution. Emerging evidence suggests that indoor air pollution is also a main contributor to COPD in some parts of the world. Indoor air pollution in developing countries is mainly the result of burning biomass for fuel indoors for domestic purposes. This negatively affects the health of billions of people, primarily women and young children due to their prolonged periods of exposure to pollutants. Despite being the third leading cause of death globally, the role of biomass burning and the resulting indoor air pollution have not been extensively studied with regard to COPD. We conducted a literature review to examine the research that has already been studied on this topic as well as comparing data between two different studies. Overall, existing research suggests a clear relationship between biomass burning and COPD in third world countries. Practical implications of this research and suggestions for future study will be discussed. **Keywords:** chronic obstructive pulmonary disease (COPD), biomass, indoor air pollution, developing countries

**Student Authors (s):** Gheorghiu, Dorothy; Duke University

**Mentors (s):** Koeberl, Dwight; Duke University

**Effect of androgen treatment on AAV-vector mediated gene therapy for female mice with Pompe disease**

Pompe disease is an autosomal recessive disorder resulting from mutations in the gene for acid-alpha glucosidase (GAA), a lysosomal enzyme responsible for breaking down glycogen. Those with Pompe disease have insufficient GAA to process glycogen, leading to accumulation of toxic levels of glycogen, causing muscle damage, hepatomegaly, and heart defects. Gene therapy treats Pompe disease through introducing the corrected copy of the gene for GAA, using an adeno-associated virus (AAV) as a vector. This precipitates expression of the viral genome in the liver, correcting Pompe disease phenotypes, as seen in mice. Males experience increased efficacy of treatment due to an androgen-dependent pathway related to striated muscle transduction. This study examines the effects of Oxandrolone, an androgen drug, on gene therapy in female Pompe mice. In order to determine if androgen therapy eliminates sex-differences in gene therapy efficacy, Pompe mice were co-treated with Oxandrolone and AAV-vector and compared to mice treated with AAV-vector alone. Female mice treated with a combination of vector and Oxandrolone, delivered at early and late timepoints, had significantly increased GAA activity, as measured in gastrocnemius, TA, quadriceps, EDL, soleus, and diaphragm tissues, compared to other treatment groups. This indicates that Oxandrolone administration timing is crucial in mediating the effects of gene therapy on GAA activity. Glycogen levels in the heart were lowered to near-normal, demonstrating positive effects of increased GAA activity, though no significant effects of Oxandrolone on GAA activity appeared. These results indicate that Oxandrolone amplifies the response of female Pompe mice to vector-mediated gene therapy.

**Student Authors (s):** Ganesan, Rajee; UNC Chapel Hill

**Mentors (s):** Furey, Terrence S.; UNC Chapel Hill

#### **Allelic Imbalance Analyses in Colonic Tissue in Crohn's Disease**

Background: Crohn's disease (CD), a type of Inflammatory Bowel Disease (IBD), is a chronic condition of the gastrointestinal tract due to an irregular immune response to enteric microbiota. To better understand genetic influences on molecular characteristics of colonic tissue, results from functional sequencing experiments were assessed for allelic imbalance where heterozygous alleles in a singular genome produce differing molecular profiles potentially affecting the function of that locus. Methods: The Assay for Transposase-Accessible Chromatin using sequencing (ATAC-seq) was performed on 32 non-IBD and 48 CD patient samples to generate paired-ends reads and identify locations of gene regulatory regions. Allelic imbalance software (WASP) was then used to perform unbiased allele-specific read mapping and discovery of sites of significant allelic imbalance. The combined haplotype test in WASP was used to determine significance ( $p\text{-value} < 0.05$ ) based on genotype probabilities at known heterozygous sites and overlapping mapped ATAC-seq reads. Results: We identified 2385 sites of allelic imbalance in CD patients and 1387 sites in non-IBD patients. 400 of these sites were found in two samples, and 97 were found in 3 samples. 8 sites were found to overlap loci identified as associated with CD in Genome-Wide Association Studies (GWAS). These loci included well-known CD-associated genes of interest, such as NOD2 and DNMT3A. Conclusions: These studies provide potential non-coding mechanisms at GWAS and other loci. Future analysis will include increasing statistical power by combining read counts across samples, as well as comparison with allelic imbalance sites in gene expression (RNA-seq) experiments.

**Student Authors (s):** Fratta, Camilla; Harris, William; Thakkar, Nihar; UNC Wilmington

**Mentors (s):** Chen, Cuixian; UNC Wilmington

#### **Visualizing and Predicting Atrial Fibrillation Using Data Mining Techniques**

Atrial Fibrillation (AFib) is the most common heart arrhythmia that is characterized by irregular and rapid heartbeats. To develop algorithms for automatically detecting AFib, we use successive R-waves in an electrocardiogram (ECG) reading, called R-R intervals. With data from the MIT-BIH Arrhythmia Database, the R-R intervals were classified into three categories (short, regular, long) based on the running means. Poincaré plots were constructed for visualizing the data. Transition matrices from the Markov process were built for further analysis. Various classifier models were tested including: Logistic Regression, Linear Discriminant Analysis (LDA), K-Nearest Neighbor, and Random Forest. With Principal Component Analysis (PCA), collinearity issues were resolved and computation time was greatly reduced. When trained on the data using Leave-One-Subject-Out Cross Validation, Logistic Regression and LDA models had an accuracy, sensitivity, and specificity over 96%, both before and after PCA. After PCA, Logistic Regression had the highest accuracy and was only slightly more computationally intensive, making it the model of choice to detect AFib in a patient.

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**Student Authors (s): Evans, Shannon; East Carolina University**

**Mentors (s): Forbes, Thompson Hollingsworth, III; East Carolina University**

**New Graduate Nurses Experience Communicating with Resident Physicians**

Miscommunication between nurses and physicians is a contributor to a staggering number of sentinel events reported to the Joint Commission but remains a poorly understood dynamic in healthcare. A previous study completed by my faculty mentor addressed how residents view their exchanges with nurses, finding that the workload of the residents greatly affects how communication is shaped. This attempted to understand the perspective of new graduate nurses who are new to discovering how to communicate with resident physicians. Therefore, the purpose of this study was to understand how new graduate nurses experience communication with resident physicians. This study used a qualitative descriptive approach to understand the perspective of a new graduate nurse. Using an email campaign, we recruited nurses that graduated from the ECU College of Nursing in the past two years and were active in practice at the bedside. We conducted 8 interviews. Interviews were audio recorded and transcribed verbatim and analyzed using qualitative content analysis. Three major themes describing the new graduate nurses' experience communicating with resident physicians were identified: Gaining Experience, Informal Communication, and Perceptions of Nurse Value. Understanding the components of communication between nurses and resident physicians, both positive and negative, provides insight into how it may be continually improved for future medical practice. Placing a greater emphasis on interprofessional communication within both nursing and medical programs would be beneficial once the students transitioned to the workforce.

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**Student Authors (s): Dheyaa, Hasan; Wake Technical Community College**

**Mentors (s): Sanders, Frieda; Wake Technical Community College**

**Effects of Antimicrobials in Preventing Bacterial Infection on Artificial Joint Materials**

For this project, I will study the effects of biomaterials in the formation of Biofilm Bacteria. The experiment should simulate possible infections on the various materials used as artificial limbs (plastic and metal). Along with the effects of the different treatments (silver and gold colloidal) applied to it. If I treat a piece of each material with gold and silver colloidal, then the pieces treated with gold colloidal should have a less bacterial infection because gold is more concentrated. Also, the metals should have a less bacterial infection on their surface because of their purity. For the experiment, I will be using four pieces of 3D printed materials resembling the plastic and four pieces of metals. To keep the environment as controlled as possible, I will be exposing three pieces of each material to E-coli bacteria, a level 1 biohazard bacteria, while exposing the last piece of each material to only water, to act as my negative control for the experiment. I will be treating one piece from each material with Gold Colloidal and one piece from each material with Silver Colloidal, leaving one piece from each material only exposed to E-coli bacteria to act as a positive control. I will also use gram stain to be able to observe the growth of bacteria and the effects of treatment on each material. I will then observe the effects of each treatment in preventing bacterial infections through a period of time. Finally, I will collect data and analyze the results.

**Student Authors (s): Dalton, Dani; North Carolina State University**

**Mentors (s): Harwood, Karey; North Carolina State University**

### **On the Development of "Female Sperm" & Same Sex Couples**

The development of "female sperm" has been studied for several years within the world of assisted reproductive technologies (ART). While this technology is new, it has tremendous potential to change the lives of soon to be parents. The first successful case of creating a zygote from two female reproductive sources occurred in October 2018 while experimenting on mice. In pop-culture happenings, artist Charlotte Jarvis independently works alongside scientists to actualize the making of sperm from stem cells. One benefit of this technology is that it will make family planning more accessible for same-sex couples. "Female sperm" brings about ethical questions concerning the health and safety of children born from this technology and questions of who will have access to it. For my research, I discuss the definition, development, and ethical concerns of "female sperm" in order to argue how the development of female sperm will positively affect the lives of those in the queer community. This technology will allow trans members to safely stay on hormones and not have to worry about sterilization, will create equity between same-sex couples and hetero normative couples who are trying to conceive, and will offer a way for same-sex couples to have children that are genetically related to both parties. I argue that there is a way to dispose of unused embryos ethically, children from same-sex couples fare just as well as children from heteronormative couples and that this technology protects the health and safety of children born from using "female sperm".

**Student Authors (s): Cartwright, Michael; Western Carolina University**

**Mentors (s): Sheppard, Francine; Western Carolina University**

### **The Association Between Volunteerism and Mental Health Outcomes in Older Adults: Implications for Nursing Intervention**

The ability to detect mental health concerns in older adulthood through social and functional assessment may allow for earlier interventions to improve mental health and maintain independence. Older women comprise the largest group of US volunteers. This study's purpose was to examine mental health outcomes in older women and analyze the association between women's mental health and volunteerism. Secondary analyses of existing data were conducted (305 retired, community-dwelling women within six Southern US states). Validated instruments were used to measure mental health outcomes (Healthy Days [CDC], Ferran's Quality of Life Index) and self-reported depression diagnosis, and number of days sad, blue, or depressed. Differences in the proportion of women were grouped by volunteering status (no volunteering and volunteering at least one day per month). The mean age in the sample population was  $73.05 \pm 8.56$  years. The sample consisted of 56.7 % white and 43.3 % all races except white. Less than a third of respondents were married and 82.3 % had secondary education or more. A weak, positive correlation was found with volunteering and education, with higher education levels for those who volunteered ( $r = 0.287$ ,  $p \leq 0.01$ ). Volunteering was weakly associated with fewer unhealthy days ( $r = -0.106$ ,  $p \leq 0.05$ ). This study's results concur with existing literature supporting volunteerism for older adults. In women, volunteering was found to be beneficial to mental health. Volunteerism may generate purpose and provide a means to decrease social isolation and promote functionality.

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**Student Authors (s):** Carter, Jenna; Campbell University

**Mentors (s):** Bunn, Jennifer;

#### **Salivary Cortisol Analysis in Collegiate Female Lacrosse Athletes**

The purpose of this study was to 1) evaluate changes in salivary cortisol in Division I female collegiate lacrosse athletes (n=18) and 2) assess the relationship between cortisol and athlete wellness and training load. Saliva samples were collected biweekly on Monday mornings during the first six weeks of the competitive season. Subjective athlete total wellness scores and subscores (muscle soreness, sleep quality, fatigue, and stress) were taken on the same days. Objective total weekly training load for distance, high-intensity distance (HID), sprints, accelerations, and decelerations were tabulated from the previous training week. **RESULTS:** There was an upward trend in cortisol (wk 1:  $0.574 \pm 0.297$   $\mu\text{g/dL}$ , wk 2:  $0.701 \pm 0.481$   $\mu\text{g/dL}$ , wk 3:  $0.772 \pm 0.603$   $\mu\text{g/dL}$ ), but no difference in time points. Week two ( $3812.3 \pm 965.3$  m) had lower HID than weeks 1 ( $2954.3 \pm 657.3$ ) and 3 ( $4084.5 \pm 998.6$  m) ( $p < .001$ ) and week three ( $37.4 \pm 16.3$ ) had the most sprints ( $p < .001$ ). Cortisol showed no relationship with muscle soreness or sleep ( $r = .043-.089$ ) and low correlations with total wellness, stress, and fatigue ( $r = .137-.218$ ). There was also no relationship between cortisol and total distance, HID, accelerations, and decelerations ( $r = .014-.096$ ) and a low relationship with sprints ( $r = .126$ ). **CONCLUSION:** Although cortisol did not correlate with wellness scores or objective data, the upward trend over collection points suggested that as the season progressed, the athletes had increasing levels of stress within the body. This stress could be a result of stress induced from performance or game settings. If carried out to completeness, this trend could be analyzed more thoroughly across the competitive season.

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**Student Authors (s):** Carrington, Deja; San Deigo, Lauren; Fuller, Tiffany;

**North Carolina A&T State University**

**Mentors (s):** Colleran, Heather; North Carolina A&T State University

#### **Dietary Patterns and Quality in Lactating Women Enrolled in A 12-Week Dietary and Exercise Study**

Obesity in America has risen to epidemic levels over the past 10-years. Retention of weight gained during pregnancy may be a contributing factor. Breastfeeding may reduce long-term maternal weight retention from pregnancy and is recommended for at least the first six-months. The purpose of this study was to assess the effects of a 12-week nutrition and exercise program on dietary patterns and quality in lactating women, who were enrolled in the MEEMA (Moms Exercising and Eating for Maintaining Health and Active Lifestyle) study. Eligible women completed baseline and endpoint three-day diet interviews recorded on the Nutrition Data System for Research (NDSR 2019, UMin). Participants randomized into the IG (n=6) underwent 12-weeks of exercise, nutrition education and were given 6-oz of yogurt 3-times/week. IG increased their fruit intake (1.1 to 1.8 servings), vegetable intake (3.3 to 4.4 servings) and total grains (1.8 to 7.8 servings) to meet the recommended servings. Dairy intake remained unchanged and below the recommendation of 3 servings/day. The Healthy Eating Index (HEI) scores for the women declined ( $59.8 \pm 6.4$  to  $54.3 \pm 11.2$  out of 100), due to a reduction in whole grain intake. Overall, IG increased consumption of fruits, vegetables, and grains; decreased consumption of sweets and protein intake to meet recommendations. The findings suggest that exercise, nutrition education, and yogurt consumption may improve dietary patterns of lactating women. However, more tailored nutrition education is needed to improve HEI scores. Funded by Evans Allen National Institute of Food and Agriculture (NIFA) USDA, grant number NC.X.-309.5-18-170-1

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**Student Authors (s):** Bynum, Libby; Campbell University

**Mentors (s):** Bunn, Jennifer;

### **Predicting Division I Lacrosse Game Performance Through Microtechnology**

The purpose of this study was to analyze relationships between external and internal load metrics with game performances for Division I collegiate women's lacrosse athletes. Data were collected using microtechnology during 26 games over a two-year period with 18 athletes (attackers  $n = 5$ , midfielders  $n = 7$ , defenders  $n = 6$ ). External load variables included: total distance, distance rate, high-intensity distance (HID), speed, sprints, accelerations, decelerations, metabolic equivalent distance (MED), and sprint speed zones. The internal load metric was training impulse (TRIMP). Individual game stats were taken from publicly available data, normalized into z-scores, and used to determine game success. Regression analyses with load metrics for game success in each position were conducted. For midfielders, distance rate, HID, TRIMP, MED, and sprints were the most important load variables for ground balls ( $r^2 = .214$ ), draw controls ( $r^2 = .265$ ), and total game success ( $r^2 = .300$ ). For attackers, MED, HID, and TRIMP were the most important load variables for shots ( $r^2 = .217$ ), shots on goal ( $r^2 = .187$ ), and draw controls ( $r^2 = .203$ ). For defenders, deceleration and HID were the most important load variables for draw controls ( $r^2 = .247$ ). These data provide specific indications of impactful load metrics for each lacrosse position. Coaches may use this information to implement specific training and drills to augment these loads for better positional preparation, improved fitness, and subsequently improved game performance. Overall, this study enhances the information available for improving training specificity in women's collegiate lacrosse.

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**Student Authors (s):** Andrews, Angel; Wingate University

**Mentors (s):** Davis, Tracy; Wingate University

### **Kratom: An Unsafe Opioid Ingested by Mice Causing Hepatomegaly that Cannot be Reversed with Naltrexone**

Kratom (*Mitragyna speciosa*), a tropical tree grown in Southeast Asia whose leaves can alleviate pain and enhance productivity, is becoming more widespread in the West as a natural and less addictive substitute for opioids. We have previously shown, using allometric doses of Kratom on C57BL/6 mice, that there was a dose-effect caused by mitragynine, found in kratom, resulting in hepatomegaly observed in as little as 3 days of consumption. The objective of this study was to determine if kratom-induced hepatomegaly can be hindered using Naltrexone, an opioid receptor antagonist. A Kratom tea was made and added to a nutrient-rich powder, in varying amounts, to create the liquid diets. The mice received a Kratom-free liquid diet for 3 days of acclimation. On day 4, osmotic pumps, containing naltrexone to deliver at 10mg/kg BW-1 per day, were surgically inserted. On this same day, the mice received either the control liquid diet or the Kratom liquid diet made at a dose of 15 mg/mL mitragynine content. After 3 days, livers were collected, wet weight recorded, and portions snap-frozen in liquid nitrogen for RNA analysis and embedded in OCT or fixed in 10% buffered formalin for histology. This experiment was done previously using Kratom tea of various doses (0.3 mg/ml or 0.03 mg/ml mitragynine content) and naltrexone delivered at 1mg/kg BW-1 per day for 7 days. In both experiments, naltrexone did not inhibit the kratom-induced hepatomegaly. Furthermore, naltrexone alone had no adverse effects on the liver.

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**Student Authors (s):** Ho, Bingxuan; Duke University

**Mentors (s):** Agris, Paul; Duke University

### **Characterizing Synonymous Codon Usage Bias in Integral Cardiac Proteins**

Currently, most treatment options only mitigate the symptoms of HF, with the dysregulation of contractile heart proteins primarily responsible for improper contraction. However, cardiovascular research has been focused on developing methods to utilize gene therapy to treat individuals with heart failure. However, clinically applicable results are scarce due to off-targeting effects. Thus, this project expects to demonstrate that physiologically critical heart proteins are regulated by the usage of rare synonymous codons- ideal candidates for improving the specificity of gene targets in cardiovascular treatment. PLN was of interest due to its five-fold over expression in the human heart and role in reducing heart contractility through calcium handling with sarco endoplasmic calcium ATP-ase. I plan to transfect Human Embryonic Kidney (HEK) cells with human phospholamban vectors utilizing lipofectamine transfection assays and create three synonymous mutants through site-directed mutagenesis at the serine 16 position of PLN (e.g. TCG → TCC, TCG → TCC, etc.) to determine if differences in synonymous codons will upregulate PLN expression in HEK cells. Next, I will quantify changes in PLN mRNA/ protein content with RT-qPCR and western blotting to analyze how synonymous codon usage at the Ser16 position influences transcriptional and translational expression of PLN. The project is expected to demonstrate differences in PLN transcript/protein expression between one WT and three mutant plasmids at the S16 codon due to the delayed sensitivity and limited availability of the cardiovascular TCG-tRNA isoacceptor during A-site binding in ribosomal translation.

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**Student Authors (s):** Schmitt, Adam; Waler, Carmen; Long, Logan; East Carolina University

**Mentors (s):** Das, Bhibha; East Carolina University

### **The Impacts of the COVID-19 Pandemic on Honors College Students' Experiences**

Purpose: The Covid-19 pandemic impacted higher education in the middle of the Spring 2020 semester, causing enormous effects on academics, quality of instruction, and quality of life for college students. With the rapid change to virtual classes and external stressors that came with the new way of life, college students faced many challenges – both academic and personal. The purpose of this qualitative study is to examine the impact of the pandemic on the learning experience of on Honors College students enrolled in the Freshman Seminar along with personal changes that may have occurred. Methods: A content analysis of COVID-19 reflection pieces was conducted by three undergraduate researchers and a faculty mentor. Results: Content analysis of reflection pieces (N = 98) resulted in eight dominant themes: 1. personal growth, 2. family dynamics, 3. economic concern, 4. mental health, 5. new normal, 6. lack of transparency, 7. social isolation, 8. an impression on others. Discussion: Data demonstrates students experienced personal growth at an exponential level that they may have not experienced if not for Covid-19. Students experienced detrimental effects of the pandemic and the rapid shift to virtual learning, such as heightened anxiety and depression and increased social isolation. Higher education professionals should support college students' mental health during these challenging times and examine ways to reduce social isolation by creating a sense of community. Future research should consider examining this cohort (Class of 2023) longitudinally to explore the long-term effects of COVID-19 on their academic and personal trajectories.

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**Student Authors (s):** Ewing, Karissa; UNC Charlotte

**Mentors (s):** Byker, Erik; UNC Charlotte

**Investigating and Comparing Aspects of Sustainable Development Goal 3**

The purpose of my research poster is to investigate and compare aspects of the Sustainable Development Goal (SDG) #3: Good Health and Well-Being. In particular, I examine the following aspects of SDG #3: (1) the impact of COVID-19 on health and well-being and (2) the interconnections between SDG #3 and the other SDGs. The two main research questions for my comparative study are: What are the similarities and differences between Australia and the United States in relation to the impact of the COVID-19 pandemic on good health and well-being? How have the two countries related or differed in their response to the interconnectedness of SDG3 to other SDGs? For this research presentation, I focus on comparisons among Australia and the United States. To conduct this research, I used a literature review research design methodology. I searched for resources on the UNC Charlotte J. Murrey Atkins Library databases using keywords like: Australia, COVID-19, good health, GDP, health reports, SDGs, United States, and well-being. My data consists of three country reports, one international dataset, and two other reliable sources. The findings of my research reveal (1) the success of SD3 is in critical condition due to the impacts of the COVID-19 pandemic and (2) the success of other SDGs is crucial in relation to the success of SDG3. The research poster includes an examination of the challenges and possibilities in meeting SDG 3: Good Health and Well-Being.

## Poster Presentations

### Physical Sciences & Astronomy

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**Student Authors (s):** Ozbek, Yasemin; North Carolina State University

**Mentors (s):** Kumah, Divine; North Carolina State University

**Investigating Spin Transport in Magnetic Oxide Systems with Ferromagnetic Resonance**

Conventional electronics that use the motion of electrons (charge current) to power devices and store memory have shortcomings, one of which is the loss of energy through the dispersion of heat generated by electron collisions. The field of spintronics has developed to reduce energy losses due to charge currents by storing and transmitting information using the spin of electrons. Hence, understanding spin transport and developing new spintronic materials is of great scientific and technological interest. In this study, we investigate the progression of spin waves in a novel complex oxide material. To do this, we utilize ferromagnetic resonance (FMR) to measure the properties of the spin current, which include the FMR peak-to-peak width and Gilbert damping parameter, which provide information on the sample's anisotropy and spin current damping respectively. This study will broaden the current knowledge of spin transport in magnetic oxides by expanding the list applicable materials.

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**Student Authors (s):** Jabusch, Noah; North Carolina State University

**Mentors (s):** Kemper, Alexander; North Carolina State University

**Ab initio calculation of superconducting properties for TiO**

Superconductivity remains a compelling field of research in condensed matter physics, as existing theories do not fully explain its mechanism in a variety of materials, including high-temperature superconductors. While the cuprates have been widely studied due to their high critical temperatures, titanium compounds also exhibit superconductivity, which is enhanced in thin films for reasons that remain unclear. We calculate the electron band structure and phonon spectrum for TiO using software based on Density Functional Theory. We also present a model based on Migdal-Eliashberg theory for computing its electron self-energy, a precursor to calculating the superconducting gap, critical temperature, and other useful quantities.

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**Student Authors (s):** Garcia-Guzman, Evert; UNC Pembroke

**Mentors (s):** Brandon, William; UNC Pembroke

**On the Origins of Matter Waves**

A simple description of matter waves lending itself quite naturally to further development in introductory modern physics pedagogy follows from the notion that inertial mass originates from the special relativistic effects of a resonant coupling between the zero-point field and charge. Using basic algebra to investigate the energy dispersion of the free electron it appears that matter waves might be attributed to a modulated wave formed by superimposing the intrinsic set of randomly phased, Lorentz transformed, Doppler shifted electromagnetic waves. Essentially, matter waves are the result of zero-point-field driven resonances modulated at de Broglie frequencies. This is a very simple version of an interpretation rigorously described earlier by researchers in the field of stochastic electrodynamics. The attraction to such an approach, for those so inclined, is the simplicity afforded in returning to an old-fashioned mechanistic understanding of the universe and an effort to break from established Copenhagen doctrine. Such a framework is provided by researchers working in the realm of stochastic electrodynamics.

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**Student Authors (s):** Deshpande, Shardool; North Carolina School of Science And Math

**Mentors (s):** Bennett, Jonathan; North Carolina School of Science And Math

**Investigating the properties of GW170729 using a Newtonian approximation**

Gravitational waves are recently discovered extrasolar messengers that carry information from astrophysical events. Unlike electromagnetic radiation, gravitational waves interact weakly with matter and are therefore virtually unimpeded as they propagate through space. We study the gravitational wave signal GW170729 from a binary black hole system to obtain source parameters for the event. We apply a Newtonian approximation to model the inspiral stage of the coalescence. We compare the efficacy of this model with the computationally intensive general relativistic model used in more complex analyses. Using data from the Laser Interferometer Gravitational-Wave Observatory (LIGO), we analyze the time-frequency evolution of the signal using a linear regression. From this regression, we obtain the key parameter of chirp mass. Using the chirp mass, we then calculate other important parameters such as the total mass of the system and the masses of the two merging black holes. We analyze the data furthermore to obtain the luminosity distance and the total energy lost in gravitational waves (Mathur, Brown, & Lowenstein, 2017). We obtain a primary black hole mass of 40.9 solar masses and a secondary black hole of 30.2 solar masses. Our model estimates a loss of energy in gravitational waves of about  $4.5 M_{\odot} c^2$ . We calculate a luminosity distance of 1284 Mpc. All of these estimates fall within the range provided by LIGO's O1 and O2 Catalog. Finally, we discuss the limitations of the Newtonian model in comparison to the relativistic model.

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**Student Authors (s):** Yalamanchi, Dhruv; **North Carolina School of Science And Math**

**Mentors (s):** Bennett, Jonathan; **North Carolina School of Science And Math**

Implementing and Evaluating the Efficiency of a Quantum Linear Systems Algorithm

We demonstrate the advantage quantum computers bring to solving computationally intensive tasks by presenting the results of determining the solutions to large systems of linear equations using both a quantum algorithm and a classical, deterministic algorithm. In the quantum approach, we implement the Harrow-Hassidim-Lloyd (HHL) algorithm for solving linear systems using a quantum programming language called Qiskit. The HHL algorithm operates using a method called eigenvalue inversion. It achieves this by producing and acting on estimates for the eigenvalues of the matrix that represents the coefficients in the system of linear equations. For the classical algorithm, we implement an algorithm in Python that computes the exact solution to the input system of equations using Gaussian elimination with partial pivoting, one of the most efficient classical algorithms. We then feed randomly generated square matrix equations representing  $n$  by  $n$  linear systems into these two algorithms and record how internal properties such as matrix condition number and sparsity impact metrics such as runtime and solution fidelity. Scaling  $n$  enables us to experimentally determine the respective time complexities of the algorithms and perform a comparison of their efficiencies. We show that, unlike Gaussian elimination, HHL has a strong dependence on condition number and sparsity and scales logarithmically in  $n$ , providing a noticeable speedup for sufficiently large systems.

## Poster Presentations

### Social & Behavioral Sciences

**Student Authors (s):** Roseboro, Telissah; **Johnson C. Smith University**

**Mentors (s):** Townsend, LaSoyna; **Johnson C. Smith University**

**Life After the Foster Care: The impact of aging out of foster care on college transition**

Foster care youth experience many issues through their transition from foster care services to college, yet are the least represented on college campuses. However, little research examines the transitioning process of these students and the coping mechanisms that are most efficient in this transition. Literature provides an overview of the challenges that these students face. The percentage of students that graduate from post-secondary institutions who have aged out of foster care is low and there is a need to understand how these students cope. The purpose of the study is to examine the impact of foster care youth aging out of the foster care system and their transition to post-secondary education. The researcher hypothesized that factors associated with support, resources and coping strategies impact college transition for students that age out of foster care. The study utilized the Schlossberg's Transition Theory to analyze the patterns amongst these students and their transition. This qualitative study was conducted by interviewing 5 students out of the 20 to be interviewed at a historically Black university. Preliminary results revealed many themes by conducting a content analysis. Preliminary results revealed three themes that were significant which are: students' sense of a positive self-efficacy, aspirations to have a high GPA as well as excitement in having positive social interactions. Results also showed that aging out of foster care did not impact students' grades, but did motivate them to be successful. These preliminary findings suggest that foster care youth aging out of the foster care system are often self-motivated individuals even when not receiving support from outside sources.

**Student Authors (s):** Lei, Carina; North Carolina School of Science And Math

**Mentors (s):** Gillan, Douglas; North Carolina State University

### **Symmetry as an Underlying Principle in Aesthetic Websites**

The correlation between aesthetics and perceived usability, especially in relation to website interface design, has been researched over the last 25 years, but the ascertainment of the underlying principles that affect human perception of aesthetics has yet to be widely studied. Our goal is to determine whether symmetry is a key factor in determining the perceived beauty of a website and the degree of its influence. In accordance to previous studies that have documented the relationship between higher facial symmetry and more facial beauty, we hypothesize that symmetry will also influence human perceptions of beauty in relation to website interface design: more aesthetically pleasing websites will have higher symmetry. To determine this relationship, 25 HA (high-aesthetic) and 25 LA (low-aesthetic) websites were chosen from Internet-based lists compiled by experts, then measured for home page symmetry using three metrics: number balance, area balance, and positional symmetry. Potential bias in choosing the websites was eliminated by assigning each website a number and using an online random number generator to choose the sample websites. A t-test and a Mann-Whitney U test showed that the number balance data was significant at the 0.1 level, but not at the 0.05 level; in other words, there is a small but not strong significance between symmetry and website aesthetics in relation to number balance. It is thus possible that symmetry is a factor in the determination of perceived beauty in relation to website interface design, but not a strong one.

**Student Authors (s):** Hubner, Sarah; Kuczura, Ema; Duke University

**Mentors (s):** Hunter, Kelly; Duke University

### **COVID-19 and Its Impact on Women in Kenya: Understanding Sexual and Reproductive Health in the Aftermath of the US's Global Gag Rule**

The COVID-19 pandemic has disrupted health systems around the world and highlighted existing weaknesses in national health systems. In Kenya, these disturbances have been widely felt, however as an already marginalized group, women and girls have been particularly impacted, especially with regard to sexual and reproductive health. Kenya, like other low and middle income countries that receive foreign aid from the US, has experienced a decrease in funding to sexual and reproductive health services due to the US's Global Gag Rule. The Global Gag Rule prohibits US global health assistance from going to foreign NGOs that perform or actively promote abortion. With the reinstatement and expansion of this policy in 2017 under the Trump administration, the funding landscape for sexual and reproductive health in Kenya was fundamentally altered, limiting many providers, advocates, and civil service organizations' ability to meet the needs of their populations. To understand the twin impacts of the US's Global Gag Rule and the COVID-19 pandemic, our team interviewed 30 non-governmental organizations focused on sexual and reproductive health and rights in Kenya. Stakeholders communicated that the Global Gag Rule and the COVID-19 pandemic have affected the need for and the provision of sexual and reproductive health services through four mechanisms: 1. Demand-side factors; 2. Supply-side factors; 3. Barriers to service access; and 4. Spillover effects. The detrimental circumstances of the COVID-19 pandemic have been compounded by the existing financial and operational restrictions of the Global Gag Rule.

**Student Authors (s):** Anderson, Grace; Geiger, Sara; North Carolina State University

**Mentors (s):** Mulvey, Kelly Lynn; North Carolina State University

### **Gender Differences in Personal Reported COVID-19 Impacts**

Unparalleled times such as global pandemics require the attention of scientists in order to bring to light the unknown. In the context of this study, researchers examined the impact of the current public health crisis, COVID-19, on the lives of adolescents from both the United States and United Kingdom. Data was collected from 194 adolescents (Mage= 17.40, SD= 1.79 years, 69.9% female) who have participated in youth programs at informal STEM sites, such as science museums and zoos. Participants completed a survey which focused on how their career goals and STEM interests have changed since the pandemic. They also gave their perspective of how the pandemic has positively or negatively impacted categories such as education, mental health, and community. Male participants reported concern for education with an average rate of 0.0857 in comparison to females at 0.1029. In the category of concern for mental health, there was a greater difference between the rates between females and males, with females still reporting higher rates of concern. In the positive spectrum, it was found that males reported positive impacts in education more often than females as a result of COVID-19 repercussions. The mean data here stood at 0.0143 for male participants, while female participants had a mean of 0.0059 in positive educational impacts. Overall, boys tended to report more positive impacts, whereas girls reported more negative impacts of COVID-19. These results suggest that researchers should further investigate how the pandemic has affected adolescents' personal outlooks.

**Student Authors (s):** Canipe, Kaitlyn; Compton, Coltan; Slawon, Rogerlyne;

North Carolina State University

**Mentors (s):** Midgette, Allegra; UNC Chapel Hill

### **Perceptions and Reasoning of Racial Microaggressions among European American College Students**

Racial microaggressions have been found to occur frequently and be especially harmful in higher education (McCabe, 2009; Suárez-Orozco et al., 2015). This study investigated how 213 European American college students (Mage=19.12, SD=1.43, 55% cisgender women) perceived and reasoned about the occurrence of such behaviors. The participants completed an online survey with five vignettes: four vignettes depicted microaggressions of invalidation and ethnocentrism, assumption of criminality, assumption of inferiority, assumption of economic privilege, and the fifth vignette presented a neutral situation. Participants then rated how realistic and negative they perceived each scenario to be and included justifications along with their ratings. Reliable coders used a coding schematic to code participants' justifications. We sought to understand which vignettes participants were less likely to recognize as a microaggression and their associated justifications. Of the four microaggression scenarios, participants were significantly less likely to recognize racial inequality in the Invalidation and Ethnocentrism and Assumption of Inferiority scenarios ( $ps < .001$ ). Between these two vignettes, participants were significantly less likely to recognize racial inequality in the Invalidation and Ethnocentrism scenario. Justifications for these two scenarios focused heavily on the authority figure (for instance the counselor or professor) with regards to how correct/incorrect the speaker's message was and whether or not they followed social conventions. Understanding participants' reasoning behind their perceptions of racial microaggressions or lack thereof can assist in creating educational interventions that motivate bystander intervention and eliminating harm resulting from invalidating the racial reality of BIPOC communities.

**Student Authors (s):** Brown, Destini; Hyman, Jada; North Carolina A&T State University

**Mentors (s):** Aiken-Morgan, Adrienne; North Carolina A&T State University

**Perceived Stress is Negatively Associated with Cognitive Performance among College and Middle-Aged African American Adults**

**Introduction:** Previous research shows that acute and chronic stress are related to cognitive function in adults. Few studies have examined these associations in African American adults. This study examined the correlations between perceived stress and cognitive performance in a pilot sample of college and middle-aged adults. We hypothesized that higher perceived stress would be associated with lower cognitive performance. **Methods:** This pilot study sample included 21 African American participants living in the Greensboro, NC area (mean age = 25.9, SD = 11.4; range=18-50 years). The Perceived Stress Scale (PSS), a global measure of perceived stress, was used to assess stress. To measure cognition, Digit Span (Forward & Backward) and Digit Symbol Substitution were administered. **Results:** Bivariate correlations showed significant associations between perceived stress and Forward Digit Span ( $r = -.092, p < .05$ ), Backward Digit Span ( $r = -.032, p < .05$ ) and Digit Symbol Substitution ( $r = -.181, p < .05$ ). Linear regression analyses showed that perceived stress was negatively associated with Digit Symbol ( $\beta = -.230, SE=.176, p < .05$ ). These results demonstrate that higher perceived stress was associated with lower cognitive performance. **Conclusion:** These pilot results suggest perceived stress is important regarding cognitive performance among African American adults. Future research should examine relationships between perceived stress in cognitive performance over time. Stress among African American college students and middle-aged adults may have long-lasting cognitive effects.

**Student Authors (s):** Wall, Avery; Steele, Taylor; UNC Chapel Hill

**Mentors (s):** Arnold, Jennifer; UNC Chapel Hill

**Implicit Learning of Discourse Patterns Through Repeated Exposure**

Pronouns are a staple of language, but they can often introduce ambiguity. If I tell you a story about Ana and Liz and say that “she went to the store,” how are you supposed to determine who I’m referencing? Depending on the context of the sentence, there are several biases we may use unconsciously to interpret these ambiguous references. In the sentence “Ana caught the ball from Liz and then she...” you are more likely to assume that “she” refers to Ana because she is the subject; the subject bias is a type of syntactic bias, which uses the structure of a sentence to determine the referent. You are also more likely to assume Ana is being referenced because she is the goal of the action (she is catching the ball); the goal bias is a type of semantic bias, which uses the meaning of a word or phrase to determine the referent. The aim of this study was to determine if repeated exposure to discourse patterns, such as the pronoun always referencing the subject, can impact pronoun interpretation. Experiment 1 examined the syntactic bias, with participants in either a subject condition (unambiguous pronouns always referenced subject) or non-subject condition. Experiment 2 examined the semantic bias, with participants in either a goal condition (unambiguous pronouns always referenced goal) or in a source condition. Both experiments showed a significant difference in responses between the two conditions, suggesting that we unconsciously adapt our interpretation strategies to match the patterns we are encountering.

**Student Authors (s): Walker, Kenya; Brown, Xxavier; North Carolina A&T State University**

**Mentors (s): Germain, Cassandra; North Carolina A&T State University**

### **Can Music Improve Cognition and Mood in Cognitively Impaired Elders?**

Setting: Community-Based Adult Day Care and Respite Centers Background: Over 50 million people worldwide are diagnosed with dementia and other related cognitive disorders. More than half of them experience behavioral problems and/or mood disturbances. These symptoms are associated with poor quality of life and placement into long term care. The purpose of this pilot study was to explore the benefits of personalized music intervention on behavioral symptoms and mood in persons with dementia. Methods: Fifteen adults with dementia were recruited for the study. Six of the 15 completed the intervention. Participants received 4 weeks of one-on-one- personalized music intervention, twice a week at an adult day center. We assessed mood using the Geriatric Depression Scale and global cognition using the Montreal Cognitive Assessment. Results: Six out of the six participants who completed the music intervention, and cognitive assessments performed significantly better on the cognitive assessment post intervention  $t(5) = -.82, p < .04, d = 0.33$ . The music intervention did not appear to have any affect on participants' mood as measured by the GDS  $t(7).00, p = 0.143$ . Discussion: Music intervention may help maintain or improve cognitive function in people with dementia and related cognitive impairments. More research with larger sample sizes is needed to determine whether these findings can be replicated.

**Student Authors (s): Walker, Katherine; Lodge, Frank; North Carolina State University**

**Mentors (s): McLaughlin, Anne; North Carolina State University**

### **Assessing the Role of Expectancy in Visual Attention During Rock Climbing**

The SEEV Model of Attention is used to predict how attention is allocated to areas of interest in a dynamic environment, using four components: Saliency, Effort, Expectancy, and Value (Wickens et al., 2003). This study focuses on Expectancy, which is the anticipation of relevant features in an environment. This study uses a data set of videos from 33 rock-climbers, ranging in skill from non-expert to expert. Each participant wore a GoPro on their helmet that approximated where climbers' visual attention was allocated. Where participants placed or attempted to place gear is a definitive marker for their attention, which is used as a dependent variable in this study. The videos of the climb were broken down into one frame per second images that were analyzed and coded using colored markings over the areas of interest on a grid system, overlaid on each image. Gear placement was coded as either placed or attempted, where climbers place or attempted to place gear on their climb. Expectancy was coded using a sample of the expert climbers; places where they placed gear were used as a template for high expectancy. The coded images will be statistically analyzed, using correlational analysis to understand if Expectancy predicts climbers' visual attention and how it contributes to the SEEV model. The goal of the larger study is to see if the SEEV model applies in such a highly dynamic environment, with application to domains such as search and rescue.

**Student Authors (s): Vann, Diamond; Elizabeth City State University**

**Mentors (s): Kaur-Walker, Kulwinder; Elizabeth City State University**

### **Effect of COVID-19 on Social Engagement on Social Engagement in Education**

The Coronavirus or COVID-19 pandemic has cost lives and jobs drastically scrambling all educational endeavors. Since March 2020, we have been trying to figure out what works, what does not work and which routes to take to accommodate everyone. Since then, many states like North Carolina have reopened schools and have developed guidance to support their schools in the state. This study's goal is to investigate how COVID-19, the social precautions and restrictions that come with pandemic, has impacted high school seniors and college students academically. The Qualtrics survey was the remote method used in order to reach the participants while adhering to the safety protocol. We used social media platforms such as Facebook, Twitter, Instagram, Snapchat and via email to reach 18 years or older high school seniors and college students for participation. The social media platforms used lead to varied participant demographics in terms of age, gender and race. The results from the data collected so far indicated that participants experienced a decline of about 72% in their social engagement, which affected them academically compared to their engagement during pre-COVID time. This study is an effort to find resolves to declined social engagement and keeping the students, parents and teachers comfortable adhering to social distancing and pursuing the academic goals. Keywords: Coronavirus, Qualtrics, survey, social engagement, social media

**Student Authors (s): Savage, Jennifer; East Carolina University**

**Mentors (s): Autry, Cari; East Carolina University**

### **Perceptions of an Adapted Virtual Reality Sailing Simulation Program for People with Physical Disabilities**

Sailing is shown to have a positive outcome on an individual's quality of life including physically, socially, mentally and/or emotionally. Virtual reality sailing simulators (VRSS) are shown to have better outcomes of the transition from sailing on land to sailing on water (Recio et al., 2013). Virtual reality to reality sailing can be particularly beneficial for people with physical disabilities. However, research is lacking on the therapeutic use of sailing, more specifically from the participants' point of view. Therefore, a research question that guided this study included: What perceptions will participants with physical disabilities have after completing an adapted virtual reality sailing simulation (VRSS) program and its contribution to their quality of life? Seven adult individuals who had spinal cord injuries, spina bifida or cerebral palsy were recruited from a local non-profit agency that focuses on active participation with those with physical disabilities. Each completed the 11 sessions in a VRSS program. Participants were then interviewed to collect qualitative data of their experience. The qualitative data were analyzed using Tesch's 8 step coding process as proposed by Creswell and Creswell (2017). Three themes were found in this study including learning, enjoyment and using the simulation as rehabilitation. Learning often presented some joy and distraction to participants' lives as well as enhancing their knowledge. The simulation also provided rehabilitation for some participants in terms of physical benefits. A discussion of this study will focus on how virtual reality can be vital to provide more leisure opportunities to individuals with physical disabilities.

**Student Authors (s):** Rodriguez, Glorimel; UNC Chapel Hill

**Mentors (s):** Telzer, Eva; UNC Chapel Hill

**Examining the Relationship Between Ethnic Identity, Peer Susceptibility, and Peer Group Norms on Adolescents' Behaviors**

In adolescence, ethnic identity (EI) development unfolds in the context of peer relationships and may have a significant impact on behavioral adjustment. However, limited research has examined the influence of EI on adolescent functioning and the role of peers in this relationship. Thus, this study tested the mediating role of peer susceptibility in the relationship between EI and adolescent prosocial and antisocial behavior, and the conditional effects of peer group norms. Participants included 470 racially/ethnically diverse adolescents (51% female) from ages 10-14 years. Self-report questionnaires completed by participants were used to measure the primary variables (EI, peer susceptibility, prosocial behavior, antisocial behavior, and positive/negative peer group norms). Using a moderated mediation model via the Hayes (2013) Process Macro, results suggested that EI predicted prosocial behavior but not antisocial behavior; however, this was not mediated by peer susceptibility. Instead, peer susceptibility predicted increased antisocial behavior at higher levels of negative peer group norms (but positive peer group norms did not buffer this relationship). Taken together, findings highlight the importance of negative peer group norms in predicting adolescent antisocial risk behavior, and the influence of EI on adolescent prosocial behavior.

**Student Authors (s):** Riddick, Molli; Kornegay, Janell; Elizabeth City State University

**Mentors (s):** Kaur-Walker, Kulwinder; Elizabeth City State University

**Exploring the Mental Health Effects of Hurricanes with Photo-voice**

Natural disasters have nearly tripled within the past 100 years, such as hurricanes, earthquakes, tsunamis, landslides, and floods with 30% of people more than likely to experience one. People who have experienced hurricanes are more likely to experience PTSD, depression, or bipolar disorder, among many other disorders. This study investigated the mental health effects of hurricanes in coastal North Carolina by using the photovoice method. Five adult participants captured pictures reminding of hurricanes and were discussed in weekly group sessions for five weeks. Each meeting session was recorded and then transcribed for coding and theme analysis. Based on coding by two independent coders, we noticed that hurricane effects included lingering mental, physical, emotional and financial stress; anxiety and PTSD. Mainly, social support through family, church and neighbors is the source of support. In many situations the county officials are usually busy trying to help their own close community or take care of their own damages, or simply unavailable at the time. Most of the participants are unaware of any mental health resources in their community, on a daily basis and in times of need when natural disasters strike. Keywords: mental health effects, hurricanes, photovoice, PTSD

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**Student Authors (s): Rahman, Fariha; UNC Chapel Hill**

**Mentors (s): Bauer, Anna; UNC Chapel Hill**

### **The Influence of Race, Socioeconomic Status, and Breastfeeding on Postpartum Depression**

Postpartum depression (PPD) is a serious mental health condition that contributes to the high rate of maternal mortality in the U.S. (Gunja et al. 2018). Recent research has identified breastfeeding cessation as one of the many risk factors associated with PPD onset, however, the relationship between breastfeeding and PPD is largely unclear (Pope and Mazmanian 2016). Both breastfeeding and PPD independently polarize black women, as they are less likely to breastfeed and more prone to developing PPD. This association may be further exacerbated by low socioeconomic status (SES) (Dolbier et al. 2013; Bascom and Napolitano 2016). Therefore, this study explores the differential impact of race and SES on the relationship between breastfeeding and PPD. This study recruited minority postpartum women from four obstetric clinics across North Carolina and collected demographic, biological, social, and trauma data. We intend to analyze the prevalence of breastfeeding and PPD in black mothers versus white mothers, and further analyze whether there is an association between breastfeeding black mothers and increased prevalence of PPD compared to breastfeeding white mothers using a logistic regression model. Based on previous research, we hypothesize there will be a lower prevalence of breastfeeding but higher prevalence of PPD in black mothers compared to white mothers. We further hypothesize there may be an association between breastfeeding black mothers and an increased prevalence of PPD. We hope the results of this study can assist researchers and practitioners in developing future interventions to improve maternal health outcomes as it pertains to PPD.

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**Student Authors (s): Pizano, Jessica; Purdie, Albert; Elizabeth City State University**

**Mentors (s): Kaur-Walker, Kulwinder; Elizabeth City State University**

### **Qualtrics Survey to Study Mental Health Effects of Hurricanes**

The main purpose of this study is to better understand mental health effects of natural disasters in the area affected by Cashie river. This area is known for experiencing natural disasters at a very high rate. The purpose of this study was to collect exploratory data using a questionnaire through a qualtrics survey link communicated to participants via email and social media links to understand the experiences of residents and their perspectives on mental health effects in the area. So far approximately 40 adults residing in the area were given questionnaire surveys links to respond to online anonymous survey pertaining to their living situation, perceptions of community issues and available community resources. Results show that 60% of the surveyed residents did not seek mental health assistance following a natural disaster prior to the study due to lack of information provided on such resources, while 30% of residents were aware of resources but were unable to access them. More data are being added that may alter the findings. Keywords: mental health, PTSD, disasters, hurricane

**Student Authors (s):** O'Neal, Isaac; North Carolina State University

**Mentors (s):** Neupert, Shevaun; North Carolina State University

**Left or Right: Political Orientation Predicts Work Stress**

Previous research indicates that levels of work stress can vary by different individual characteristics such as personality, age, and income. However, there is less extensive research analyzing the relationship between work stress levels and political orientation. The purpose of this study is to investigate the relationship between work stress and six personality traits, age, income, and political orientation. Using data from the 2018 U.S. Midterm ES-CAPED (Election Stress Coping and Prevention Every Day) study, 140 participants were surveyed. Participants represented 35 different U.S. states and American Samoa and ranged in age from 19-86. On day 1, participants reported age, income, and political orientation. Work stress was reported each day for 30 consecutive days from October 15, 2018 to November 13, 2018. This was measured using a yes/no question, which asked the participants if they had experienced stress at work that day. Correlation results showed that people who reported more work stress tended to be older and reported high agency and low conscientiousness. In line with our expectations, results from a multiple regression revealed that political orientation significantly predicted work stress over and above these effects, such that people who identified as more liberal tended to report more work stress than those who identified as more conservative. Future research could build upon this study by analyzing the relationship between political orientation and stress in other domains of life, such as interpersonal relationships.

**Student Authors (s):** Nguyen, Luke; UNC Chapel Hill

**Mentors (s):** Muscatell, Keely; UNC Chapel Hill

**The effect of cultural, familial, and socioeconomic factors on Asian American help seeking attitudes compared to White Americans**

Past research has shown that Asian Americans (AAs) have low levels of help-seeking behavior for mental health and higher levels of mental illness than the national US average. In order to better understand why AAs display low levels of these help-seeking behaviors, this study investigates how acculturation, family conflict, and socioeconomic status (SES) associate with help-seeking attitudes in AAs relative to White Americans (WA), who served as the control group. Based on existing literature, researchers hypothesized that low acculturation, high family conflict, and low SES would be negatively associated with lower help-seeking attitudes in the AA group compared to the WA group. A sample of 491 college students (237 AA, 254 WA) were asked to complete a survey measuring the specified variables listed above. Results demonstrate that race has a significant effect on help-seeking attitudes, with AAs having lower help-seeking attitudes than WAs. Acculturation, family conflict, and SES had no correlation with help seeking attitudes in the AA group. On the other hand, in the WA group there was a negative correlation between family conflict and help-seeking attitudes. Being AA was significantly associated with lower help seeking attitudes and higher family conflict than in the WA group. Future directions for research about AA help seeking include investigating the relationship between coping strategies and help seeking attitudes, as well as comparing differences between AA subgroups instead of using a WA control group.

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**Student Authors (s):** Merritt, James; East Carolina University

**Mentors (s):** Habeeb, Christine; East Carolina University

**An investigation of the effects of collective efficacy on performance in a team rope-pulling task**

In team situations, an individual's performance can seem subjectively different depending on their teammates due to a complimentary effect between self, teammate, and collective efficacy (Bandura 1977, 1997; Lent & Lopez, 2002). The purpose of this study was to examine any corresponding effects from changes in both self and teammate-efficacy on collective efficacy (CE) in relation to performance to establish a relationship in team settings. In dyads, unacquainted male participants ( $n = 20$ ) participated in a three round team rope-pulling competition. As per Dunlop, Beatty, and Beauchamp (2011), bogus feedback, designed to manipulate the participants' levels of both self and teammate-efficacy, was presented in the form of one of four randomly assigned conditions: high-efficacy (A), mixed-efficacy (B,C), and low-efficacy (D). Initial results indicated that participants in the front position who received condition D saw the greatest force increase ( $M = 23.4\%$ ) between the practice and competition rounds, while those who received condition B saw the lowest increase ( $M = 11.9\%$ ) even though participants reported similar CE ( $M = 83.3, 83.8$  respectively). Interestingly, while having the highest level of CE ( $M = 92.9$ ), the participants who received condition A saw a moderate increase in force ( $M = 15.9\%$ ), which was only slightly above the participants in condition C ( $M = 12.4\%$ ), who had the lowest levels of CE ( $M = 75$ ). From this, it can be concluded that beliefs about personal and teammate ability help to explain the complex relationship between collective efficacy and performance in team settings.

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**Student Authors (s):** Koster, Melissa; East Carolina University

**Mentors (s):** Curtindale, Lori;

**Children Watching Fantastical Content and Executive Functioning**

The purpose of this study is to better understand the effect of fantastical content in children's TV shows as it is related to executive functioning (EF). This project will examine the research question: Is there a relationship between the percent of fantastical shows watched and a child's EF? Fantastical content is described as breaking naïve physics, impossible transformations (character's body changes shape, character spins and their clothes change, etc.), and fantastical beings (fairies, unicorns, etc.). The target group is typically developing children aged four- to six-years. Parents will first complete the demographic and EF section of the questionnaire by themselves. The EF section is the Ratings of Everyday Executive Functioning (REEF) questionnaire. It contains statements that a child with a well-developed EF would exhibit and assigns a score for EF. The higher the score, the more developed the EF. Following that section, they will help their child complete the fantastical section. This section is comprised of forced-choice questions that make a child choose between a fantastical show and a non-fantastical show. This allows us to gain an understanding of how many fantastical shows the child prefers to watch over non-fantastical shows. After finishing the questionnaire, the percent of fantastical shows selected will be calculated and correlated to the corresponding EF score. A Pearson correlation will be computed to assess the relationship between the percent of fantastical shows selected and EF score. It is hypothesized that the larger the percent of fantastical shows selected, the lower the EF score will be.

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**Student Authors (s):** Kimble, Laney; North Carolina State University

**Mentors (s):** Meitzen, John; North Carolina State University

**Perinatal Exposure to FireMaster® 550 Yields Sex-specific Effects on Mate Bonding in Prairie Voles**

Perinatal exposure to environmental chemical contaminants can disrupt neural function, and consequently potentially disrupt social behavior. One possible contaminant are chemical flame-retardants, which are contained within consumer products including infant products, electronics, furniture, and mattresses. One of the most common flame retardants in use since the early 2000s, is FireMaster® 550 (FM 550) which contains brominated and organophosphate compounds. These chemicals have been shown to leach from the products to which they are applied and accumulate in house dust, providing a route for ingestion by humans. One scientific gap in knowledge is how FM 550 exposure may impact social behavior. To assess this challenge a prairie vole animal model was employed. Prairie voles exhibit prosocial behaviors including social monogamy and biparental care, unlike other laboratory rodents. Vole dams were exposed to 1000 µg dose of FM 550 throughout gestation via subcutaneous injection, and pups were exposed beginning the day after birth until weaning. Pair bond formation and strength of adult animals of both sexes were assessed using a partner preference test. Effects were sex-specific with exposed female animals exhibiting increased preference for the partner animal, while pair bond formation among exposed male animals resembled that of untreated animals. This study demonstrates the utility of prairie voles as an animal model for examining social behavior and indicates that FM 550 impacts elements of social behavior. Future work will explore the mechanisms by which this occurs, and work to confirm the sex-specific effects of this chemical.

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**Student Authors (s):** Johnson, Brittany; North Carolina State University

**Mentors (s):** Neupert, Shevaun; North Carolina State University

**Across the Aisle: How Anticipatory Coping Affects Election Stress in Conservatives and Liberals**

There is existing literature that indicates elections are often stressful for people. However, the research on counteracting election stress is limited. This study's purpose is to evaluate the effectiveness of anticipatory coping in reducing election stress. We used data from the ESCAPED (Election Stress Coping and Prevention Every Day) study, which provided daily diary responses from 140 participants across the U.S. and American Samoa, ages 19-86. Participants were recruited using Amazon's Mechanical Turk (mTurk) and were asked to fill out an online survey each day for 22 days before, the day of, and 7 days after the 2018 U.S. midterm election, which fell on November 6, 2018. Questions involved the exposure participants had to election-related events as well as ratings of anticipatory stress, anticipatory coping, and negative affect. After utilizing multilevel models, we found the effectiveness of anticipatory coping was dependent on the political orientation of the participants. Those who identified as conservative were unaffected by anticipatory coping; however, those who identified as liberal experienced more emotional reactivity to election-related stress with the use of anticipatory coping. These results highlight the differences between individuals of different political orientations in terms of the effect of anticipatory coping, which can be important in identifying effective coping strategies that help to reduce the effects of election stress.

**Student Authors (s): Jewell, Ansley; North Carolina State University**

**Mentors (s): Gonultas, Secil; North Carolina State University**

### **Bystander Acceptability Judgments and Reasoning of Gender-Based Social Exclusion of College Students**

College students frequently experience gender-based social exclusion, especially in STEM classes (Ganley et al., 2018). Bystanders are key actors to stop social exclusion; their moral judgments and reasoning make significant differences in creating an inclusive campus climate. However, our knowledge is limited in how bystanders' moral judgments shape their reasoning for gender-based social exclusion. We examined bystander responses to gender-based exclusion by measuring how acceptable participants found the excluding behavior to be, as well as the reasoning for their evaluation. We surveyed 208 college students whose ages ranged from 18-31 years (Mage=19.20, 128 female). Participants were randomly assigned to two conditions in which they read a story: Exclusion of Male Student from English Class or Exclusion of Female Student from Physics Class. Then, they evaluated the acceptability of gender-based social exclusion and the acceptability of group members' support of gender-based social exclusion. After each acceptability evaluation, participants were presented with reasoning questions (Why?). Participants' open-ended responses were coded, and ANOVAs were used to examine differences in reasoning by the acceptability of exclusion and group support to exclusion (acceptable/unacceptable), condition, and gender. Results showed that participants who evaluated exclusion and group support as unacceptable attribute fairness more in their reasoning while participants who evaluated exclusion and group support as acceptable refer more to group functioning. No significant differences were found by condition or gender. Our results provide important implications to examine different motives behind bystanders' moral judgments about gender-based social exclusion to promote positive bystander responses.

**Student Authors (s): Holloman, Armani; Payne, Samantha; Elizabeth City State University**

**Mentors (s): Kaur-Walker, Kulwinder; Elizabeth City State University**

### **An Examination of Mental Health Effects of Hurricanes in Coastal North Carolina to Strengthen the Efforts of Resilience**

Recent research has identified mental health as an important emerging factor in the conversation of disaster resilience and recovery. Previously, the conversation was geared towards infrastructural resilience only. The goal of this study was to assess the prevalence of mental health issues in a community repeatedly affected by hurricanes and accessibility to mental health services through focus group and interviews of community members. Ten participants from hurricane effected areas were recruited via social media and five questions were asked as probes to discussion. The responses were analyzed by three coders to find recurring codes and themes. Results showed that the hurricanes left residents without power, hot water to take hot showers, and an inability to cope with their losses. Mental health deterioration seemed evident with limited resources for individuals who needed assistance with mental health issues. Sometimes residents are not even approved of certain available services that could help them; though some are not knowledgeable about the provisions. For physical damage, the vulnerable people are left to worry until someone fixes the aftermath caused by the hurricane. This study has recommendations for making mental health services accessible to the vulnerable community. Keywords: focus group, individual interview, accessibility, mental health services.

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**Student Authors (s):** Hochberg, Elizabeth; North Carolina School of Science And Math

**Mentors (s):** Feng, Jing; North Carolina State University

#### **Human Interaction with Automated Vehicles**

Car companies are working to achieve self-driving cars in order to eliminate driver responsibility, human error, and ultimately reduce the number of accidents and dangerous situations that are encountered during driving. A review of the current studies reporting human interaction with level 2 and level 3 automation is important to know how to take the next steps in manufacturing; there are 6 levels of vehicle automation, ranging from level 0 (fully manual) to level 5 (fully autonomous), and level 3 cars are close to coming on the market. There have been videos circulating social media that show drivers misusing the level 2 automation features which further emphasizes the importance of studying how drivers will interact with these systems, especially in emergency situations. I reviewed 30 research articles and extracted how they conducted their research and presented their findings of the presentation of the automation systems, take over requests, and non-driving related tasks on a simulated driving experiment. Results showed that engaging in such tasks does correlate with longer take-over times in emergency situations, which pose more of an accident risk. Surprisingly, there were no significant differences in reaction time due to the type of task (ie watching videos vs reading). However, the uses of required secondary engagement in tasks and simulator environments foster an unrealistic driving experience which calls for further testing in different environments. This review showed that while significant steps are being taken to achieve level 3 automation, more research is necessary to gather more uniform results.

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**Student Authors (s):** Hawes, Ashlynn; Elon University

**Mentors (s):** Allison, Meredith; Elon University

#### **Assessing Alibis: Salaciousness, Strength of Evidence, and Timing of Disclosure**

We investigated mock juror perceptions of alibi believability because a disbelief in alibis has contributed to wrongful convictions (Wells et al., 1998). Mock jurors (N = 276) read a fabricated police report and trial description in which a suspect was accused of a drug-related felony. Participants read one of eight alibis: the alibi was either disclosed early to the court (one day after case was set for trial) or later (three weeks after); a salacious alibi (the defendant claimed to be taking an exam for his friend in exchange for payment at the time of the crime) or nonsalacious alibi (the defendant claimed that he was taking his own exam); and an alibi that was corroborated by physical evidence (a receipt) or an alibi with no mention of physical evidence. Participants answered questions measuring their perceptions of the defendant's character, the alibi's believability, and their dichotomous verdict decision. Alibi believability ratings were higher for nonsalacious alibis than for salacious alibis ( $p < .001$ ). Similarly, the defendant was viewed positively on all eight character traits when the alibi was not salacious ( $ps < .05$ ). Alibi timing had little impact on the dependent measures. However, the presence of physical evidence affected defendant trustworthiness; Surprisingly, the defendant was seen as more trustworthy when he did not have a receipt than when he did. The majority of participants found the defendant not guilty (67.4%) and this pattern was not affected by any of the independent variables. Limitation and future directions will be discussed.

**Student Authors (s):** Harwood, Kira; D'Amelio, Christina; Linnick, Jenna; Catawba College

**Mentors (s):** Brownlow, Sheila; Catawba College

#### **Effects of Self-Referencing and Positivity on Effectiveness of Instagram Posts**

We examined whether personal narratives paired with positive/negative messages in Instagram posts produced differential post effectiveness in women. Participants provided their evaluation of a fictitious Instagram post that either included self-referencing or not, and which varied in valence. Positive posts were well-received compared to negative posts, as women saw them as more likely to be influential for themselves and others; self-referencing was not important to evaluations. Results were not a function of baseline self-reported healthiness nor various personality measures. Results suggest that motivation to attend to health-related information in social media may be higher when the message is uplifting.

**Student Authors (s):** Guinn, Hope; North Carolina State University

**Mentors (s):** Simons-Rudolph, Joseph; North Carolina State University

#### **Free association: Psychology's Approach to the Undergraduate Major**

Academic curriculum in higher education serves as both a roadmap to earn a degree and an overview of the field as a whole (APA, 2013). Psychology is the fourth largest major in the country (APA, 2017), and is a strong foundation for a wide range of careers or graduate study (Landrum & Harrold, 2003). The Psychology major has two purposes: to prepare students seeking graduate education with knowledge and research skills that are specific to the discipline and to prepare students seeking post undergrad employment with skills and qualities desired by future employers (Strohmetz et al, 2015). However, in comparison to other degree programs, such as biology or engineering, Psychology's curriculum has little structure and contains few course sequences (Halpern, 2010). The APA developed guidelines for the undergraduate major which focus more on the course objectives and individual level outcomes among common psychology courses (APA, 2016). However, the guidelines provide very few suggestions about the overall organization or timing of courses in the major. (APA, 2016, Halpern, 2010). In general, Psychology programs require between seven and ten courses, about one-fourth of the required courses for an undergraduate degree (Halpern, 2010). Further, with limited structure, two students with the same undergraduate degree in psychology could graduate with dramatically different sets of knowledge, skills and viewpoints of the discipline at large. As such, a stronger structure to the degree could better support the students' journey to a degree and clarify knowledge and skills earned within the degree program.

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**Student Authors (s): Guiler, William; Walker, Carmen; North Carolina State University**

**Mentors (s): Dolbier, Christyn; North Carolina State University**

### **Qualitative Investigation of ECU Student Stress & Coping During the COVID-19 Pandemic**

**Introduction:** This research study was originally designed to assess undergraduate student stress and coping annually. With the onset of COVID-19, a new set of stressors arose which necessitated the need for different or new coping strategies. The purpose of this study was to assess stress and coping specific to COVID-19. This presentation focuses on a qualitative analysis of participants' open-ended responses to their different stressors and how they are coping during the pandemic. **Method:** Students were recruited from psychology classes (N=727) across six weeks starting in mid-March of 2020 just after the university moved to remote learning due to the pandemic. The average age of participants was 20.66 years, with the majority being female (76%) and white (67%), and relatively equal percentages across student year. A stress and coping survey was administered. Two open-ended items asked participants to describe three main stressors caused by the pandemic and three main ways they are coping. **Results:** The most common themes identified as major stressors pertaining to the pandemic include: social/leisure activity modification (53.7%), largescale pandemic concerns (40.3%), academics (37.4%), and concerns about loved ones (32.3%). Common themes identified as ways of coping with the pandemic include: social connection (41.4%), health-promoting behaviors (35.5%), leisure activities (24.3%), and media consumption (23.9%). **Conclusion:** From the qualitative analysis, students seem to be mostly stressed about having to modify their daily routine in response to coronavirus restrictions. To cope, they are relying on social connections with friends, family, and loved ones.

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**Student Authors (s): Deguzman, Melanie; North Carolina State University**

**Mentors (s): Neupert, Shevaun; North Carolina State University**

### **Let's Get Physical: Physical Activity and Cognitive Functioning in Older Adults with Cognitive Impairment**

Existing literature links health biomarkers such as blood pressure to cognitive impairment. Specifically, hypertension and hypotension are said to be markers for onset (Lattanzi, Briogo, Vernieri, & Silverstrini, 2018; Davis, Massman, & Doody, 2003). However, less extensive research exists when tying in age, stress, and physical activity. In an ongoing study, 41 cognitively impaired older adults in the U.S. participated with ages ranging from 60 to 87. Participants completed a survey that recorded demographic information (e.g. age, whether or not they have a formal diagnosis of cognitive impairment, and the frequency of physical activity) Blood pressure was recorded during cognitive testing and cortisol levels were measured by collecting hair samples. Participants also completed cognitive tasks that measured episodic memory and working memory. Correlation analyses showed that higher frequency of physical activity participation was associated with higher cognitive ability. No significant correlations were found for blood pressure, cortisol levels, and age in relation to cognition. This study points to the value of physical activity, suggesting that participation in physical activities may be especially important for those who are already experiencing cognitive impairment. Further studies can focus on the relationship between the type of physical activity and cognitive impairment, as well as incorporating other factors such as diet, mindfulness, and coping strategies.

**Student Authors (s):** Chiralde, Penelope; Alegria, Juliet; Shelton, Ria; Midgette, Allegra; UNC Chapel Hill

**Mentors (s):** Hussong, Andrea; UNC Chapel Hill

### **The Challenges Parents Face During Conversations about COVID-19 with their Children**

The COVID-19 pandemic has greatly impacted families in the United States. Scholars have suggested the benefits of family communication in times of crisis (Dalton, Rapa, & Stein, 2020); however, less is known about how family members are communicating about the COVID-19 pandemic. The present study investigated how families are approaching conversations about COVID-19 through parent-reports on the difficulties and successes they experience in having these conversations with their children. Our sample consisted of 86 parents ( $M_{age} = 41$ ,  $SD = 5.33$ ), 88% mothers, 81% European American, 8% Asian American, 4% African American, 3% Latinx, and 4% Other) in North Carolina who had children between 12- and 16-years of age ( $M_{age}=14$ ,  $SD=1.18$ , 54% female). As part of a larger study of families' experiences with the COVID-19 pandemic, parents were asked two open-ended questions: "What is the hardest part of these conversations about the outbreak?" and "What do you think has gone well in these conversations?" Coders inductively coded their responses in a qualitative analysis to identify themes. Our analysis revealed that parent's own uncertainty about the future made conversations with their children about the pandemic challenging. On the other hand, parents reported that children appeared to understand why COVID-19 precautionary measures have been taken and expressed gratitude for their situation. Our present study suggests that parents may be better supported in their conversations with their children by being provided with more information about COVID-19.

**Student Authors (s):** Campbell, Sydney; UNC Charlotte

**Mentors (s):** Bennett, Jeanette; UNC Charlotte

### **Posttraumatic Growth & Adversity: How Characteristics of the Adverse Event Affect Health Outcomes Among Young Adults**

**Background:** Adverse life events may alter an individual's health, but much less is known about how characteristics of the event can influence this relationship. Posttraumatic growth (PTG) is the positive psychological change that arises following the struggle of experiencing a traumatic event. Most of PTG research has focused only on traumatic events, hence a gap in knowledge exists as to whether general stressful life events can lead to PTG and improve health outcomes. **Method:** Young adults ( $N=211$ , 61% female, 65% white) completed an online survey that captured stressful life events, including the most stressful and the level of PTG following that event, as well as current mental and physical health. PROCESS Macro for SPSS model 3 examined a three-way interaction between PTG, time since event and event type (traumatic or interpersonal stressor) on mental and physical health. **Results:** The 3-way interaction was significant for both health outcomes. Specifically, higher PTG following a more recent interpersonal stressor appears to be linked with better health outcomes, while higher PTG following a more recent traumatic event is linked to worse health outcomes. As time passed, increasing PTG was only associated with better physical health. **Conclusion:** Results indicate that PTG and health are associated within individuals regardless of adverse event type, a novel finding. Furthermore, this relationship seems to be influenced by the recency of the event, where current mental and physical health may be altered by more recent events, while only physical health is influenced by PTG over the long-term.

**Student Authors (s):** Callaway, Caroline; North Carolina State University

**Mentors (s):** Neupert, Shevaun; North Carolina State University

### **The Mask of Social Activities: Protection from Depression in Older Adults with Cognitive Impairment**

Emotional well-being and cognitive ability are determined by one's biology, lifestyle, and environment (Balouch et al., 2019). Through the lens of social psychology, it would be serviceable to examine whether social activities could have an impact over quality of life for older adults with cognitive impairment. The current ongoing study aimed to examine if social activities were associated with mental well-being and cognitive functioning. A total of 41 cognitively impaired older adults (60-85 years) participated in the study. Depressive symptoms were measured using the Geriatric Depression Scale (GDS; Sheikh & Yesavage, 1986). Social activities were assessed through a modified version of the Victoria Longitudinal Study Activities Questionnaire (VLSAQ; Jopp & Hertzog, 2010) and cognitive functioning was measured by several tasks that measured episodic memory and working memory. Regression analyses revealed that the frequency of social activities was not associated with cognitive ability, but was inversely related to depression. This shows that participants who engaged in social activities more frequently also had fewer depressive symptoms. Notably, the negative association between social activity and depression did not differ between participants who participated before and during the COVID-19 pandemic. The results suggest that social activities may have a protective effect on depression in cognitively impaired older adults. Future studies could utilize this information in larger samples to understand if social activity, and aspects like social networks, have an impact on emotional disorders in cognitively impaired adults.

**Student Authors (s):** Blackwell, Alexis; Elizabeth City State University

**Mentors (s):** Kaur-Walker, Kulwinder; Elizabeth City State University

### **COVID19 Effects on Current Undergrad Students and High School Seniors Heading to First Year of Undergrad**

As the spring semester of 2020 drastically changed because of COVID19 and the stay-at-home orders, so did student engagement on university and lower level schooling campuses. Students were no longer to fully engage with their professors or teachers face to face and enjoy time alongside their peers. Every assignment was now strictly through remote learning and contact with one another was also online instead of normally being in person. The purpose of this study is to examine how the drastic decrease in engagement that came as a result needs to be researched to understand how COVID-19 affected student learning. An online Qualtrics survey was used to collect quantitative data from high school seniors and undergraduate college students aged 18 years and over. Participants (200) were recruited via social media and mass emails. Of the responses, 93% suggested that students who usually participated in campus and classroom activities declined in engagement with others as everyone was sent home to start remote learning. The results showed that those who did not engage before also did not try to engage more during online learning, but that they engaged even less as the semester progressed. Numbers in the results showed that students struggled in efficiently learning and contacting professors or teachers and keeping in contact with peers. This caused more stress on students than there was when students remained on campus.                      Keywords: student engagement, learning, COVID19, research

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**Student Authors (s):** Bell, Kristina; North Carolina State University

**Mentors (s):** Morris, Irwin; North Carolina State University

**The Politics of Pandemic Response: Does Partisanship Matter?**

From the earliest days of the COVID-19 pandemic in the U.S., perceptions of the severity of the pandemic have cleaved along partisan lines. Using temporal data on COVID-19 restrictions and social distancing measures by state, we were able to determine the extent to which political factors impacted individual states' responses to the pandemic. We found that both COVID-19 restrictions and social distancing were strongly associated with partisanship, with "blue" states having the highest average levels of COVID-19 restrictions and social distancing adherence, and "red" states having the lowest. Additionally, we found that support for President Trump is strongly associated with lower levels of COVID-19 restrictions and lower levels of social distancing. Thus, we have concluded that political affiliation plays a role in government- and individual-level responses to the COVID-19 pandemic.

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**Student Authors (s):** Baker, Destiny; North Carolina Central University

**Mentors (s):** Jackson, Karen; North Carolina Central University

**Beats Me: Exploring the Impact of Marching Band on the Mind**

Marching Band is a key component of many U.S. colleges. Members are expected to excel on and off the field while juggling the daily task of being students. This excessive workload can lead to lack of academic, physical, and mental health care. Depression, anxiety, and eating disorders are a few examples that exist on campuses, including in marching band communities. Marching band consumes at least 20 hours a week, including individual and organized practices. In this presentation, I will explore the impact that being a student and marching band member has on one's mental health, how academic performance is affected, and how faculty and administrators can help members balance their academic, personal, and marching band schedules to perform better mentally and academically. To support my research, I have studied the results of a survey completed by the University of North Texas that explores the history of college marching band members. From there, I created an online survey where I requested background information and assessed the students' emotional and academic progress. I hypothesize the results from my original survey will show that while students enjoy marching band, more emphasis should be placed on helping them maintain academic success and quality mental health. Students should gain the skills and experiences that marching band provides while excelling and earning their degrees. By properly observing and supporting the mental health of these students, aspects like marching band students' graduation rates will increase.

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**Student Authors (s):** Awuah, Alexis; UNC Greensboro

**Mentors (s):** Keane, Susan; UNC Greensboro

**The Protective Role of Social Skills between Negative Affectivity and Externalizing Behaviors in Middle Childhood**

Previous research has found that childhood negative affectivity (NA), characterized by higher levels of frustration and sadness, is associated with externalizing behaviors, especially non-compliance and aggression. Social preference, or likability, has been identified as a protective factor, mitigating externalizing behavior for high NA children. However, the specific social behaviors that likely contribute to peer preference, that is, effective negotiation, cooperation, and communication skills have not yet been examined. Thus, the present study examined the moderating role of social skills on the relationship between NA and externalizing problems. It was hypothesized that children with higher NA and higher levels of social skills at age 7 would show decreases in externalizing behaviors at age 10. The current sample included 257 children and mothers (46.3% males). Utilizing maternal reports, NA was assessed using the Children's Behavior Questionnaire (age 7), social skills was assessed using the Social Skills Rating Scale (age 7), and externalizing behavior was assessed using the Child Behavior Checklist (age 10). Controlling for earlier levels of externalizing behavior at age 7, a hierarchical regression analysis revealed a significant interaction ( $\beta = -.075$ ;  $p = .030$ ). Upon probing the interaction, social skills was significant at the average and lower levels. Thus, as children's NA increased, having lower levels of social skills predicted increases in externalizing behavior by the age of 10. Findings suggest that higher levels of social skills may be advantageous for children with NA. Given the protective nature of social skills, parents and teachers can promote the learning of this skill in early childhood.

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**Student Authors (s):** Avalos, Emily; Fogleman, Emily; Roman, Keshon; Catawba College

**Mentors (s):** Brownlow, Sheila; Catawba College

**Hard Times: Biases as a Function of Embodied Cognition**

We examined how tactile stimulation influenced judgments of others by having participants touch hard or soft items and then make evaluations of an accused criminal depicted in a police report. Participants who touched soft items (in comparison to hard items) were more likely to see the accused in a "harsher" light, ascribing criminality to him. Results are discussed in terms of salience of the haptic manipulation and the use of explicit, rather than implicit, measures of bias.

**Student Authors (s): Aurelius, Courtney; Elizabeth City State University**

**Mentors (s): Kaur-Walker, Kulwinder; Elizabeth City State University**

### **The Comparison of COVID-19 Effects on Rural and Suburban Areas**

Coronavirus (COVID-19) is a contagious virus that has made its way into all demographics worldwide. In this study, we compared the effect of COVID-19 constraints on health behaviors and psychological well-being of populations in suburban and rural areas as people in different geographic areas have different challenges. We collected data on health behaviors and well-being of 50 adult residents of North Carolina (NC) rural counties and New York (NY) suburban using a questionnaire with 56 items via SurveyPlanet. The participants varied in ethnicity, gender, occupation, and age ranging from 22 to 60 years. The results showed that COVID-19 had a considerably higher impact on rural populations as 7.35% of North Carolina resident participants were not working before or after COVID-19 constraints, 25% during COVID-19 constraints became jobless and 17.67% had either a steady income from pension, social security, supplemental, inheritance, investments or from any other sources amongst our NC participants. The results for New York resident participants revealed that 6.25% were not working before or after COVID-19 constraints, 20% during COVID-19 constraints became jobless and 15.65% had either a steady income from pension, social security, supplemental, inheritance, investments or from any other sources. The reported loss of life in rural and suburban communities was at 37.62% and 15.73% respectively. Overall the rural areas were impacted more and experienced more of loss of life due to COVID-19. We need a larger sample size to get a clearer picture.

**Keywords:** COVID-19 constraints, rural, suburban, North Carolina, New York, well-being, health behaviors

**Student Authors (s): Amaresh, Sneha; East Carolina University**

**Mentors (s): Lee, Jospeh; East Carolina University**

### **Student Experiences of Undergraduates from Migrant or Seasonal Farmworker Families: Implications for an Undergraduate Research Experiences Program**

**BACKGROUND:** College students from migrant and seasonal farmworker (MSFW) families face many barriers to educational attainment in the United States: sporadic schooling experiences, cultural and communication barriers, low pay, discrimination, and health issues from farm work. Retaining students from MSFW families in higher education and research is critical for addressing health and educational inequities. In an effort to provide research experiences for MSFW undergraduate students, we conducted interviews to inform program development by exploring the research experiences of university students and recent graduates from MSFW families. **METHODS:** Ten college-age students from three North Carolina universities were interviewed by phone between March 25th, 2020, and June 17th, 2020. A qualitative approach with inductive and deductive thematic coding was used to analyze the transcripts (average length of 23.4 minutes) in the software NVivo to identify themes present across the student experiences. **RESULTS:** There were five overarching themes: Finances, Interviewee's Life, Isolation, Research, and Resources. Within those, were subthemes that more specifically categorized the qualitative data. The subthemes present within the overarching themes are: Lack of Guidance, Ethnic Identity, Interviewee's Agricultural Background, Lack of Diversity, Discrimination, Language Barriers, Mental Health, Research Barriers, Research Facilitators, and Student's Interest/Experience with Research. **DISCUSSION:** Our findings show that research programs for undergraduate students from MSFW families are of interest to students and should take into account the context of students' experiences as (often) first-generation students in primarily White (PWI) institutions, include advice to successfully navigate college, and have strong marketing and outreach efforts to reach potential participants.

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**Student Authors (s):** Agarwal, Sachi; Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)

**Mentors (s):** Bailey, Nina; UNC Charlotte

**Attacker or Victim: An Analysis of Gender Bias on Gun Use**

Gender stereotypes carry many effects and repercussions. This study researched the extent to which this impact influences people's assumptions of gun holders. A survey and experiment were conducted with fifty and six participants respectively. Participants were presented with a series of images and asked to assess the situation in each of them. Each picture depicted a scenario involving a figure holding a gun. People were asked to describe the person they thought the figure was holding a gun at. The results showed that an unidentified figure was assumed to be male 100% of the time. A woman pointing a gun was assumed to be an attackee 95% of the time. The man was only assumed to be an attacker when a "cold" facial expression was shown. The implemented stereotypes may lead to bias within the American justice system and societal biases.

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**Student Authors (s):** Rainey; Brevard College

**Mentors (s):** O'Leary, Allison; Brevard College

**Substitution Sensitivity: A Scientific Name for a Phenomenon (Most) Everyone Falls Victim To**

When answering a complicated question, the human mind will often consciously or subconsciously exclude details to make the question easier to understand and answer. This phenomenon is known as "substitution" and is a mechanism which keeps the brain from being overloaded with more details than what can be seen and heard at one time. This study is being conducted to test whether or not people are sensitive to the fact that they are substituting. Behaviorally, this natural process can be observed by measuring the accuracy of the person answering said question, which is then compared to their confidence. The packets are a series of four tests, each of which have four questions and are counterbalanced to account for confounding variables. Two are the math problems, either the standard (the question people are more likely to fall victim to substitution) or the control question (the question that is easier for people to answer), and two questions to assess their confidence in their answers. The results of the independent t-test and the means from comparing the standard and control confidence ratings to the standard accuracy proved that people are unaware that they are using substitution. There were few differences in confidence ratings, whether the students substituted or not. Further, every student but two fell victim to substitution. The findings of this experiment did conclude that the study did not replicate which showed people are not sensitive to when they make an error. Keywords: Confidence, accuracy, substitution, independent t-test

**Student Authors (s):** Duerr, Emily; Sanyal, Ameya; Duke University

**Mentors (s):** Rieder, Amber; Duke University

### **A Formative Study on Stress, Family Functioning, and Caregiving in the Context of COVID-19**

With the outbreak and continued spread of COVID-19, lockdowns, layoffs and public measures to contain the virus have significantly impacted day-to-day life, particularly for families. Parents and caregivers may be navigating remote work or facing job loss and unemployment-related stressors. Children out of school or child care may suddenly lack structured access to educational activities or opportunities for social interaction. For populations that are socially vulnerable, these detrimental effects may be heightened (Cluver et al., 2020). To understand the impact of the COVID-19 pandemic on family stress, functioning, and well-being, the Puffer Lab developed and is administering an online survey battery to families with children in the American South. As part of this study, a literature review was conducted to understand the construct of social vulnerability in the context of COVID-19 within the city of Durham, N.C. and across the greater Research Triangle. Special attention was given to recruitment of socially vulnerable populations, including (but not limited to) racial, ethnic, and socioeconomic minority populations. Next steps include finalization of baseline data collection, data analysis and re-administration of survey measures to measure change. Data will be relevant to a post-pandemic setting, where health and economic impacts continue to persist. The Puffer Lab hopes to use the collected data in order to develop a virtual intervention, delivered by lay providers, that reduces conflict and improves problem-solving, connection, and supportiveness within families in North Carolina.

**Student Authors (s):** Porter, Hannah; Gorham, Amyia; Maha Issa; Meredith College

**Mentors (s):** Norcross, Pamela; Meredith College

### **The Effects of Dress Codes on Female Adolescent Identity Development**

Adolescence is a time of transition from being a child into becoming an adult. A time for adolescent students to examine who they are, and who they want to become. Clothing is an important medium that can be used as an outlet for self-expression, particularly for female students. Accordingly, strict school dress code policies may negatively impact student's social identity development by limiting opportunities for self-expression, while promoting cultural, racial, and gender bias (Vopat, 2010). Often, dress code enforcement is subjective and arbitrary. Females often report receiving negative messages about their bodies. Thus, the purpose of this study was to examine the effects of dress code policy and messages female students receive about their bodies. A qualitative study was conducted, including a combination of open-ended questionnaires and a focus group, with participants that consisted of female students ages 13-18 years (N=9). Data were coded; gender and the body emerged as themes from both the questionnaires and focus group. Participants typically reported negative commentary from peers and adults about their bodies, and they elaborated in the focus group that they felt self-conscious about what they wear to school as a result of the scrutiny that accompanies consequences of dress code policy enforcement. Further, findings suggest enforcement of dress code policies in schools needs major reevaluation, as messages from adults are influential. Without major shifts in policy, young women are at risk of losing educational time, developing poor self-image, and valuing oneself only through the way they appear. N=247

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**Student Authors (s):** Ledenyi, Madeleine; UNC Charlotte

**Mentors (s):** Guo, Yuqi; UNC Charlotte

**Factors Associated with HPV Vaccine Uptake in LGBTQ: A systematic review**

The Human Papillomavirus (HPV) is a sexually- transmitted virus in humans. In the United States, approximately 79 million males and females are infected with HPV. Approximately 20,700 HPV- related cancers are found in women, and 14,100 are found in men yearly. Although the LGBTQ population is a sexual minority in the United States, they are disproportionately impacted by HPV. This disparity must be addressed to ensure better quality of prevention and care amongst marginalized groups. The purpose of this analysis is to understand the multitude of factors that intersect in an individual's success in receiving the HPV vaccine. By using the PRISMA statement guidelines, studies on HPV vaccine uptake among LGBTQ populations published in peer reviewed journals before June 16, 2020 were reviewed systematically. All studies were screened and coded by two independent reviewers and consensus was achieved. The initial search yielded 3170 potential articles. After duplicates were removed, of the remaining 2230 records, 26 articles were included for coding, based on screening title and abstract, and full-text review. The facilitators of HPV vaccine uptake in LGBTQ populations were age, education levels, HPV literacy, HPV vaccine knowledge, and healthcare use. The barriers of HPV vaccine uptake in LGBTQ populations were lack of insurance, misbelief of HPV, high cost, lack of healthcare access, and sexual orientation related stigma. Developing HPV education programs based on identified factors, offering incentives to qualified LGBTQ individuals, and health care providers' recommendation of HPV vaccine can help increase vaccination rate in LGBTQ populations.

562

**Student Authors (s):** Jackson, Justice; Johnson C. Smith University

**Mentors (s):** Turner, Tiffanie; Johnson C. Smith University

**Slaughter of the Innocents: Alcohol Industry using Advertising to Target Young Adults in College**

Why are alcohol impaired accidents a common issue among young adults? The research began with investigating factors that contribute to young adults (18-24) driving under the influence (DUI). The purpose of the proposed research is to explore the business aspect of the alcohol industry and alcohol impaired accidents, and to discover if the alcohol industry uses marketing tactics to target and persuade young adults to drink. The main aspect of the research will focus on how much of an impact the alcohol industry has on young adults, including all external factors that contribute to DUI. Research and observations showed that heavy episodic and binge drinking increase the likelihood of DUI among young adults. Preliminary research led to the following provoking question: Does the alcohol industry's use of marketing strategies to target and influence young adults to drink, increase the likelihood of DUI and the rate of alcohol impaired accidents amongst this group.

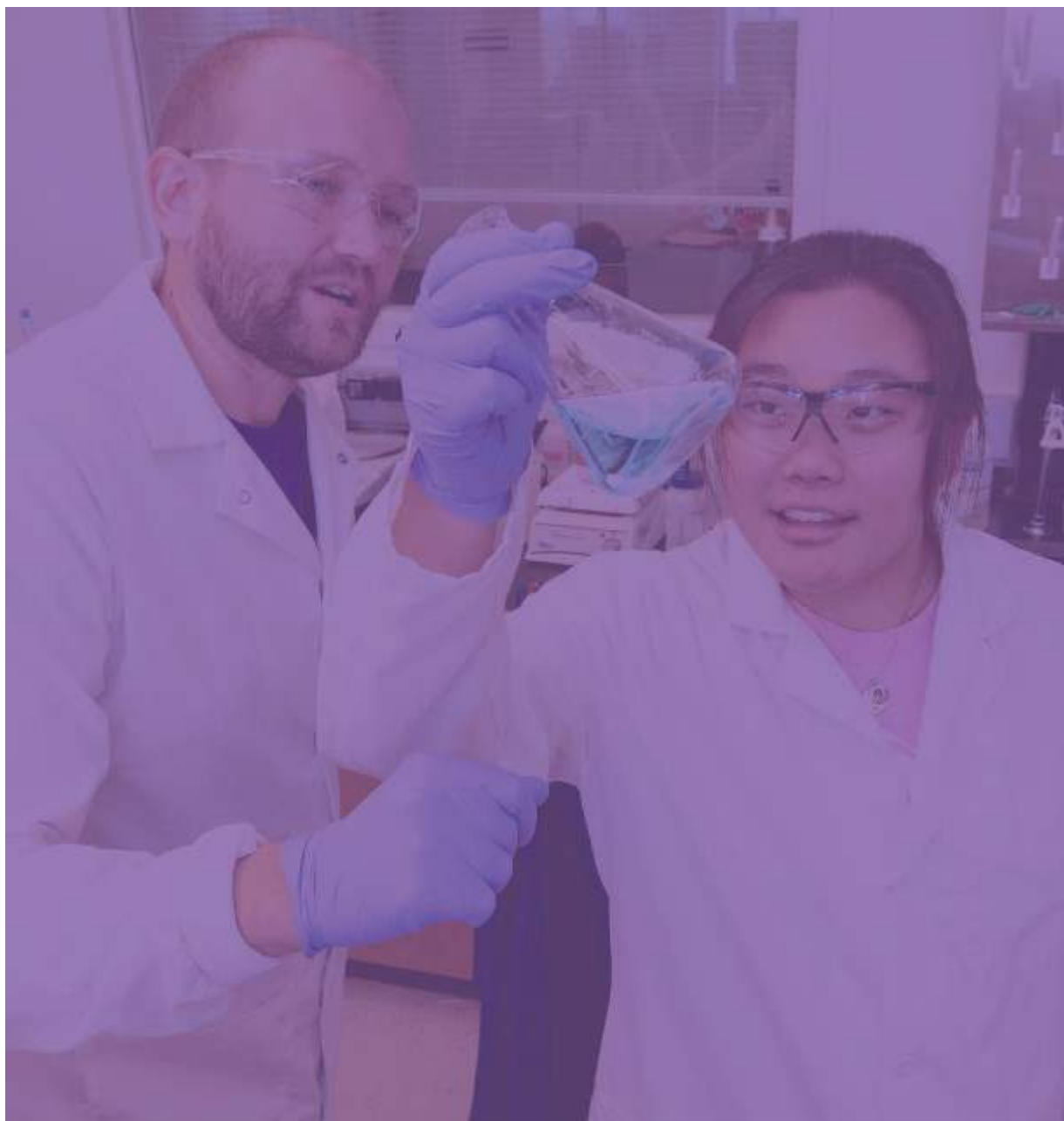


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# QUICK GUIDE

Graduate School Admissions at East Carolina University\*

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## ABOUT ECU

ECU is a comprehensive University with a nationally ranked medical school, a dental school, doctoral programs in biomedical sciences, and a College of Engineering and Technology.

Popular programs include master's degrees in biomedical engineering, business administration (MBA), public health (MPH), communication, psychology, and numerous MAEd programs in a variety of teaching disciplines. Popular certificate programs include autism, health communication, health informatics, marketing and many others.

ECU offers campus-based, online and hybrid options in many programs.

## ADMISSION REQUIREMENTS

To be admitted to a master's or doctoral program, you must have the equivalent of a U.S. bachelor's degree from a regionally accredited university.

- TOEFL requirement:  
IBT – total score: 78, section scores: 18
- IELTS requirement: 6.5
- GRE minimum requirement for regular admission:  
30th percentile of averaged combined verbal and quantitative score
- GMAT minimum requirement:  
MBA – 500, M.S. in accounting – 500

Programs may offer waivers for standardized test scores. Contact programs for details.

Conditional admission may be offered to international applicants without submission of TOEFL or IELTS or GRE scores. Conditional admission requires successful completion of the language academy at East Carolina University and submission of GRE scores prior to full admission in an academic program. For information about the ECU Language Academy, visit [ecula.ecu.edu](http://ecula.ecu.edu).

## APPLICATION PRIORITY DEADLINES

Fall semester	February 1
Spring semester	September 1
Summer sessions	February 1

## HOUSING INFORMATION

For information on housing options, preferences and deadlines, please visit [www.ecu.edu/campusliving](http://www.ecu.edu/campusliving).

## THE STUDENT BODY (FALL 2018)

Total enrollment:	28,718
Undergraduate:	23,071
Graduate and doctoral:	5,113
Medical and dental:	534
Minority students:	28% (includes graduate, medical and dental students)

## THE FACULTY (FALL 2018)

Faculty members:	2,069
Faculty holding a doctorate or other terminal degree:	82%

## ESTIMATED STUDENT BUDGET\*

The following is an estimated list of expenses for an ECU graduate student during the 2019-2020 nine-month academic year.

	Resident	Nonresident
Tuition and fees	\$ 7,536.00	\$ 20,685.00
Medical insurance	1,313.50	1,313.50
Living expenses	12,390.00	12,390.00
Books and supplies	954.00	954.00

\* Because East Carolina University is a constituent institution of the University of North Carolina, tuition and fees for the fall and spring semesters of each year are determined in part by the preceding session of the North Carolina General Assembly.




## CONTACT INFORMATION

Graduate School  
131 Ragsdale Building  
Mail Stop 570  
East Carolina University  
Greenville, NC 27858-4353

Phone: 252-328-6012  
Web: [www.ecu.edu/gradschool](http://www.ecu.edu/gradschool)

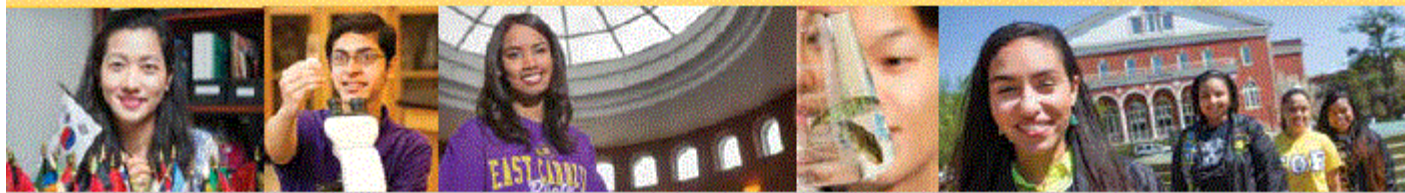
East Carolina University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award baccalaureate, master's and doctoral degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia 30033-4097 or call 404-679-4500 for questions about the accreditation of ECU. East Carolina University is committed to equality of opportunity and prohibits unlawful discrimination based on the following protected classes: race/ethnicity, color, genetic information, national origin, religion, sex (including pregnancy and pregnancy-related conditions), sexual orientation, gender identity, age, disability, political affiliation and veteran status.

## CONNECT

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## Professional Advancement Opportunities, Graduate Degrees, and Certificates

Are you interested in continuing your education or advancing your career?

Would you like to pursue a professional program?

Do you want to broaden your knowledge and learn new skills?

Would you like to continue doing research at the graduate level?

If you answered "Yes!" to any of these questions, then you may benefit from a:

- MS degree in Biology
- MS degree in Chemistry, with a Professional Science Masters concentration
- MS degree in Geology
- MS degree in Geography
- PhD in Biomedical Physics
- Interdisciplinary PhD in Biology, Biomedicine, and Chemistry
- PhD in Health Psychology

Or any number of graduate degrees and certificates offered in Harriot College at: <https://thcas.ecu.edu/graduate-programs/>

### ECU Admissions Information

#### Graduate Application

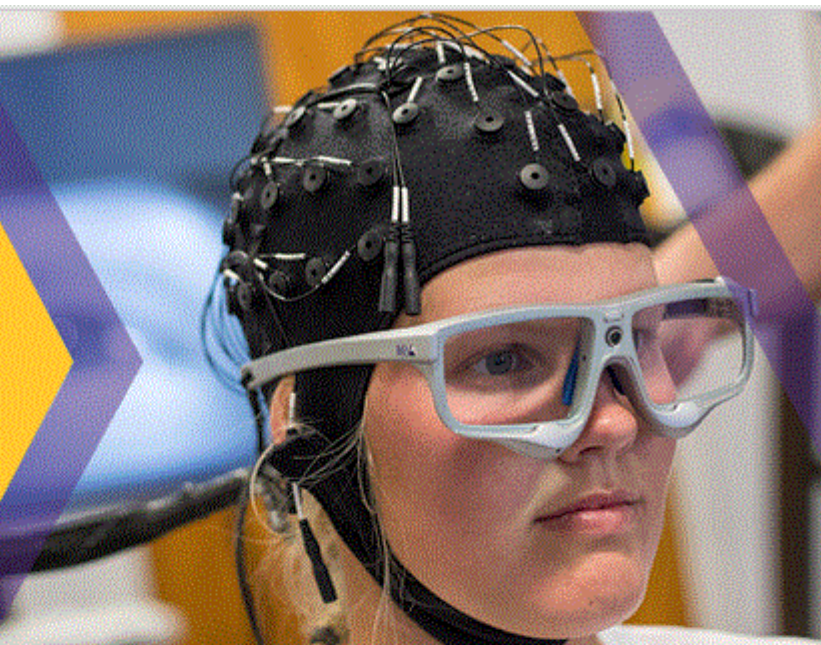
#### Financial Support:

Most Masters degrees have financial support available in the form of graduate assistantships. PhD degrees offer tuition support and health insurance as well as assistantships.

Current tuition and fees are available on the Financial Services webpage at: <https://financialservices.ecu.edu/cashiers-office/>



# Master of Science in Kinesiology



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### ACADEMIC CONCENTRATIONS

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Tom Raedeke, PhD  
RaedekeT@ecu.edu | (252) 737-1292

### EAST CAROLINA UNIVERSITY

Greenville, North Carolina  
www.ecu.edu

### MORE INFORMATION / APPLY ONLINE

[hbp.ecu.edu/kine/mskine/](http://hbp.ecu.edu/kine/mskine/)

## Online Masters Programs

**Instructional Technology**  
**Mathematics Education**  
**Science Education**

### **Master of Arts, Master of Science - Instructional Technology**

The 36-hour Master of Science in Instructional Technology prepares individuals to work in corporate, government, K-12, and higher education settings designing instruction and producing instructional media. <https://bit.ly/2GZ9wCJ>

The 36-hour Master of Arts in Education (MAEd) in Instructional Technology prepares candidates to plan, implement, and evaluate effective technology programs in P-12 education. It leads to recommendation for North Carolina licensure for computers in education and is particularly valuable for educators seeking positions as technology facilitators, coordinators, or directors in public schools. <https://bit.ly/2GZ9wCJ>

### **Master of Arts in Education - Mathematics Education**

The 36-hour MAEd is typically completed in two years by part-time graduate students who are full-time teachers. Faculty work hard to help students develop into a professional network of mathematics educators and many graduates use the master's degree work as a springboard to National Board Certification. Specific mathematics education courses are offered online during the academic year while MAEd students are teaching. This allows participants to use their classroom as a laboratory for testing ideas, piloting assessment items, and performing action research. <https://bit.ly/3iZ9x6T>

### **Master of Arts in Education - Science Education**

36 semester-hours of course work including professional education and science education courses which generally take candidates 2 years to complete. The MAEd degree is appropriate for science teachers licensed at the "A" level and interested in pursuing advanced licensure (i.e., "M" level licensure). The 36-semester-hour program is delivered online. Past graduates of the program have gone on to receive National Board Certification, assume teacher-leadership roles in their schools and districts, pursue doctoral study in science education at prestigious universities, and/or become professional development leaders in NSF-funded science education reform projects. <https://bit.ly/33VvnE2>



**ECU**

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More information about MSITE Graduate Programs

**Dr. Ron Preston:** MSITE Director of Students

East Carolina University • 252-328-9355 • [prestonr@ecu.edu](mailto:prestonr@ecu.edu)

# GRADUATE EDUCATION *Matters*

## GRADUATE EDUCATION INFORMATION

At ECSU graduate education is characterized by small classes and personal interactions conducive to the pursuit of individualized goal attainment. Students and faculty work side-by-side to study and investigate important topics and relevant issues. Within the university environment, students have the freedom to seek new knowledge through innovative research and discovery.

## DEGREE PROGRAMS

- Master of School Administration
- Master of Education in Elementary Education
- Master of Science in Biology with concentrations in Applied Biology and Biology Education leading to "M" licensure
- Master of Science in Mathematics with concentrations in Applied Mathematics, Community College Teaching, Remote Sensing, and Math Education leading to "M" licensure

## ADMISSION REQUIREMENTS

- A completed online application: <https://gradapply.ecsu.edu>
- An earned Bachelor's degree from an accredited college or university
- Contact the Office of Graduate Education for overall qualifying GPA
- A \$30.00 nonrefundable application fee
- Two official transcripts from all colleges and universities attended
- Statement of Purpose or Educational Philosophy
- Three Recommendation Forms from persons qualified to evaluate the applicant's abilities to pursue graduate studies
- Graduate Record Examination (GRE) or Miller Analogies Test (MAT) recommended but not required.
- Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS), if applicable Completed Financial Guarantee Form, if applicable Completed NC Residency Form, if applicable Completed Health Form
- TOEFL or IELTS (for international students) results within the past 5 years

Apply online at [gradapply.ecsu.edu](https://gradapply.ecsu.edu)

Office of Graduate Education | 252.335.3293 | [graduateeducation@ecsu.edu](mailto:graduateeducation@ecsu.edu)  
[www.ecsu.edu/academics/graduate](http://www.ecsu.edu/academics/graduate)



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# NATIONAL SCIENCE FOUNDATION GRADUATE RESEARCH FELLOWSHIP PROGRAM

The NSF Graduate Research Fellowship Program (GRFP) is the nation's flagship program directly supporting graduate students in science, technology, engineering, and mathematics (STEM) fields. The GRFP provides fellowships for graduate study that leads to a research-based master's or doctoral degree in STEM or STEM education, selecting individuals early in their graduate careers based on their demonstrated potential for significant achievements in science and engineering.

## ABOUT THE PROGRAM

- GRFP is NSF's flagship program directly supporting graduate students in STEM fields
- NSF welcomes applications for interdisciplinary programs of study and research
- Since 1952, NSF has awarded over 60,000 Graduate Research Fellowships
- Over 40 GRFP Fellows have later won Nobel Prizes
- GRFP seeks to broaden participation in STEM of underrepresented groups
- **NSF especially encourages women, minorities, persons with disabilities, and veterans to apply**

## GRFP FIELDS OF STUDY

- Chemistry
- Computer and Information Science and Engineering
- Engineering
- Geosciences
- Life Sciences (includes Biological Sciences)
- Materials Research
- Mathematical Sciences
- Physics and Astronomy
- Psychology
- Social Sciences (includes Economics)
- STEM Education and Learning Research

**UNDERGRADUATE SENIORS  
ARE ENCOURAGED TO APPLY!**

## PROGRAM CYCLE

Online application module opens in July and closes in October. Competition results are announced by April.

## WHY APPLY?

NSF Graduate Research Fellowships are awarded to individuals in the early stages of their graduate study. Fellows are free to use their Fellowship at any university, college, or non-profit institution of higher education accredited in, and having a campus located in, the United States, its territories, or possessions, or the Commonwealth of Puerto Rico that grants a graduate degree in a STEM field.

## FELLOWSHIP BENEFITS

The NSF Graduate Research Fellowship Program (GRFP) provides Fellowships to individuals selected early in their graduate careers based on their demonstrated potential for significant achievements in STEM. Three years of financial support is provided by the program for graduate study that leads to a research-based master's or doctoral degree in STEM or STEM education.

Benefits Include:

- Five year fellowship period with three years of financial support
- Annual stipend of \$34,000
- Cost-of-Education allowance of \$12,000 to the institution
- Professional development opportunities (internships)
- No post-graduate study service requirement
- Access to supplemental funding to sustain research while on medical deferral (e.g. family leave)
- Facilitation Awards for Scientists and Engineers with Disabilities (FASSED)

## ELIGIBILITY REQUIREMENTS

- United States citizen, national, or permanent resident
- Must intend to pursue a research-based Master's or PhD program in a STEM field
- Must have completed no more than one academic year of graduate study as of the application deadline
- Graduate students are limited to only one application to GRFP, submitted either in the first year or second year of graduate school
- Confirmation of acceptance in a graduate degree program in a STEM field is required at the time of Fellowship acceptance
- See current Program Solicitation for full guidelines

## QUESTIONS?

Please visit the following websites for additional information:

For official program information: [www.nsf.gov/grfp](http://www.nsf.gov/grfp)

For application assistance: [www.nsfgrfp.org](http://www.nsfgrfp.org)

For application submission: [www.research.gov/grfp](http://www.research.gov/grfp)

Contact us at: [info@nsfgrfp.org](mailto:info@nsfgrfp.org) or 1-866-NSF-GRFP (673-4737)



Graduate Research Fellowship Program (GRFP)

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  - At Virginia Tech, we approach admission from an inclusive, rather than exclusive, perspective using a holistic admissions process.
- **Professional Certificates**
  - Virginia Tech offers 75 graduate certificates in a variety of disciplines across the university's colleges and campuses and online.



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## Participants by University

Appalachian State University	4
Barton College	1
Belmont Abbey College	5
Brevard College	2
Campbell University	11
Catawba College	1
Chowan University	1
Davidson College	1
Duke University	24
East Carolina University	37
Elizabeth City State University	17
Elon University	13
Fayetteville State University	13
Forsyth Technical Community College	2
Gaston College	3
Guilford College	1
High Point University	10
Johnson C. Smith University	6
Meredith College	8
Methodist University	2
North Carolina A&T State University	8
North Carolina Central University	20
North Carolina School of Science And Math	74
North Carolina State University	50
Queens University of Charlotte	6
Shaw University	2
Summer Ventures in Science and Math (App State, UNC-C, UNC-W, ECU)	13
University of Illinois at Chicago	1
University of North Carolina - Asheville	1
University of North Carolina - Chapel Hill	32
University of North Carolina - Charlotte	26
University of North Carolina - Greensboro	6
University of North Carolina - Pembroke	7
University of North Carolina - Wilmington	5
Wake Technical Community College	3
Western Carolina University	1
William Peace University	3
Wingate University	4



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***Saturday, November 7***



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