



**OUR Summer 2020 Research Program**

**Abstract Book**



# Congratulations

Congratulations on your participation in the 2020 Office of Undergraduate Research (OUR) Summer Research Program. During such an unprecedented time in our country, you have exhibited great courage, strength, perseverance and resilience to complete a virtual summer research experience. As a participant in the summer research program, you have been actively engaged in faculty paired-research, peer and faculty mentoring, and professional development.

The mission of the OUR is to support undergraduate students through undergraduate research grants and opportunities to communicate their research to others through multiple research symposiums, funding to national conferences to present their research, and research exploration events. We would like to thank Academic Affairs, UNC Charlotte faculty mentors, and community partners for working with us this summer and providing students with a rewarding summer research experience.

The OUR Summer Research Program would not be possible without the commitment of our UNC Charlotte faculty. Our faculty members have served as research advisors and mentors. I'd also like to extend a *Big Thank You* to our faculty for your service and dedication to undergraduate research and scholarship at UNC Charlotte.

Lastly, I would especially like to recognize the OUR Faculty Fellows and OUR staff, all of whom played integral parts in making this program a success. Most of all please join us in congratulating our Undergraduate Researchers for their hard work and efforts.

As you reflect on this summer research experience during such an unprecedented time in our country, remember that your UNC Charlotte family is here for you and WE ARE ALL IN THIS TOGETHER!

Best Regards,  
Dr. Erin Banks  
Assistant Dean of the Office of Undergraduate Research

# Charlotte Community Scholars

Title: Conducting Research Privately: A Case Study on Vulnerable Groups

Student Author: Justin Carrasquillo

Faculty Mentor(s): Dr. Liyue Fan

College: Computing and Informatics

Vulnerable community members, such as refugees, can easily be exposed to multiple dangers, so many go about living their lives as cautiously as possible. This is especially true as technology keeps growing, further putting these communities at risk from online sources where personal data is collected and held. This study examines literature to identify privacy concerns held by vulnerable communities and analyzes privacy-safe datasets to find ways to assist these communities. Utilizing various research papers from researchers who worked with vulnerable communities and organizations that work with these communities, such as the United Nations High Commissioner for Refugees (UNHCR), we were able to identify multiple concerns held by community members, such as concerns of what their collected data will be used for, and how their data will be collected. To address those concerns, privacy-enhancing techniques should be adopted at the time of data collection and data analysis. To illustrate the usefulness of privacy-safe datasets, we are utilizing SafeGraph's open data to identify patterns, such as median distance traveled and median time spent not at home, that show certain behaviors that could put vulnerable community members at further risk. With this information that we would gather from the datasets, we hope to inform these communities as well as other stakeholders on what certain behaviors may lead to higher risks. Since we have not finished studying the datasets we do not have results as of now, but our expected results are to successfully find the information we need from the datasets to benefit vulnerable communities.

Title: Funding in Non-profit Arts Organizations: A Case Study of Lórien Academy of the Arts

Student Author: Sofia Escotto-Pimentel

Faculty Mentor(s): Dr. Vaughn Schmutz

College: Liberal Arts and Sciences

Many non-profit arts organizations in Charlotte aim to bring cultural capital and enrichment to underserved communities. For example, Lórien Academy of the Arts provides opportunities for low-income youth to receive visual arts training to develop their creativity, confidence, and critical thinking skills that equip youth for success in other areas of their life. Like many non-profit arts organizations, Lórien Academy relies heavily on individual and corporate donations to sustain its programs. The purpose of this study is to identify organizational characteristics and strategies that are most effective in helping arts-based non-profits to maximize donor engagement and charitable giving. The knowledge gained will help Lórien Academy improve their donor engagement strategies. To accomplish this purpose, I will review previous research, including surveys of donors conducted for similar purposes, as well as similar organizations' assessments of donor engagement and fundraising strategies. Based on this information, I will design a survey specifically for Lórien Academy's donor population. Donors will be recruited by email to take an online survey that will gauge their level of involvement with the organization, explore their motivations for contributing to Lórien Academy, and assess the effectiveness of the organization's current engagement strategies. In tandem with administering the surveys, I will also explore how Lórien Academy and several similar arts-based organizations in Charlotte use their websites to solicit contributions and engage with donors. After the surveys have been collected, we will analyze results to provide a comprehensive summary for Lórien Academy to better understand its own donors and to recommend further actions for enhancing donor engagement.

Title: Nurturing Our Gardens: Community Wellness Narratives

Student Author: Tyra Favorite

Faculty Mentor(s): Dr. Janaka Lewis

College: Liberal Arts and Sciences

This research, conducted during the historic events of the summer 2020 COVID-19 pandemic followed by the civic unrest stemming from the unjust execution and brutality of Black men and women by law enforcement, looks to the increased visibility of a movement for Black people to move to a place of reconnecting with the earth through buying and growing plants, gardening and/or buying fresh produce, and utilizing nature as a form of wellness for an increase in mental, physical, and social well-being. More specifically, this research will focus on Black women within this movement as not only are they the face of this campaign through various media, businesses, and organizations, but Black women have historically toiled the land for themselves, their families, as well as for society. This research will serve as a digital archive capturing the current online presence for the movement as it begins to rapidly increase in prevalence during these times. Throughout this archive, diverse digital mediums will be analyzed including blog posts, social media posts, articles, podcasts, and public videos. Also, within the Charlotte community, as well as state and nationwide, Black women owned and/or ran businesses and organizations catering to the connection between Black women and the Earth will be included for viewing. Some of these same women, as well as Black women social media influencers, will be interviewed in ongoing research to receive varying perspectives on this intertwining web of wellness, blackness, and womanhood. This archive will be formatted and presented through a website as to be relevant with the contemporary research topic in addition to being an accessible, online record of this movement.

Title: Changing Negative Perceptions on Lockwood through Oral Histories

Student Author: Keshawn Mathews

Faculty Mentor(s): Dr. Nicole Peterson

College: Liberal Arts and Sciences

Community Dream Builders, a local non-profit, is working to create a better community within the Lockwood Community by changing the narrative with togetherness through social engagement. Community Dream Builders is located in Charlotte, NC, which is where the Lockwood neighborhood is located. Community Dream Builders have created programs such as Leaving it Behind and North Carolina Wellness Expo that promotes healthy living and youth improvement. Community Dream Builders is partnering with Dr. Nicole Peterson for the Lockwood Legends project to collect the oral histories of Lockwood residents to explore how the neighborhood has changed over the years. The hypothesis of this project is that gentrification influences long-term residents negatively however the residents have also seen some benefits from recent changes. We have gained data from recording the interviews of the residents in the Lockwood community. I have edited recordings to focus on the main points that the residents spoke on when describing the community. After analyzing the data, we compared the recurring themes that appeared common between the different residents, such as residents' ideas of how the community can change to become better. The results revealed that long-term residents had seen that their housing prices had increased, the community is more exclusive, and memorable places are being replaced with other things unknown to the residents, such as local grocery stores. Nevertheless, the interviewees did believe that the community has become more urbanized and beautiful overall. In conclusion to this study, gentrification had multiple impacts on people and the community as a whole.

Title: Arts Education Program Analysis of Lórien Academy of the Arts

Student Author: Shanara Mercer

Faculty Mentor(s): Dr. Vaughn Schmutz

College: Liberal Arts and Sciences

A variety of non-profit organizations in Charlotte offer arts-based programs to address patterns of inequality. One such organization is Lórien Academy of the Arts, which provides visual arts lessons to low-income students from West Charlotte during the summer. Lórien Academy's goal is to enhance the confidence, creativity, and critical thinking of the youth that participate in their arts enrichment program in order to benefit them in other parts of their life. The program strives to encourage middle school and high school aged children to rise above the circumstances of poverty. Students are introduced to the necessary skills and abilities to progress despite social barriers, such as a sense of valued self-worth, work ethic, and discipline. The purpose of this study is to explore what other similar arts-based programs that target disadvantaged youth in Charlotte are seeking to achieve. Using qualitative methods, I will examine the goals of organizations that use different types of art education to impact the lives of young people in Charlotte. My results will summarize the different goals and strategies used by several arts-based programs. Based on a more detailed case study of Lórien Academy of the Arts, I will also address the question: how well do the goals of such programs align with their accomplishments? To determine the overall experience and influence of Lórien Academy of Arts, I will analyze the students' post-program assessments from the summer of 2019. Analysis of their answers will allow me to assess any advantages or benefits that the students themselves feel they obtained from participation in the program. Results will provide Lórien with additional understanding of their program's impact on its participants and offer insights to help other programs achieve their goals.



Title: Charlotte Food System Resilience in the Face of the COVID-19 Pandemic

Student Author: Ellie Nanney

Faculty Mentor(s): Dr. Nicole Peterson

College: Liberal Arts and Sciences

Resilience is a quality that has become greatly sought after since the unprecedented outbreak of the COVID-19 virus. Resilience, within a food system, is the ability of a complex network of shareholders to adapt quickly to disruptions, and provide the same, consistent level of food accessibility, availability, and affordability that was enjoyed by households before the disruption occurred. As evidenced by empty grocery store shelves and increased demand at local food banks, the global pandemic has disrupted the already delicate food system of Charlotte, North Carolina. The goal of this research is to identify challenges faced by local organizations during the COVID-19 pandemic, and through collaborative efforts with the Charlotte-Mecklenburg Food Policy Council, formulate solutions that will help the food system endure future disruptions. Literature review was used to gain preliminary knowledge about other cities' food systems, define the concept of resilience, and record problems that food organizations had previously experienced during widespread disruptions. Phone and video conference interviews will be conducted to assess new or exacerbated challenges that organizations have faced, identify how organizations have adapted to a post-pandemic world, and gather input regarding how policies, communication, and resources can be improved upon to facilitate a more resilient food system in the future. Data from this research may be utilized by the Charlotte-Mecklenburg Food Policy Council in their administration of the 2020 State of the Plate assessment, which will use surveys and analysis to present a more comprehensive review of household food insecurity and the resilience of the food system in Charlotte.

Title: Describing the Experiences of a Professor Teaching within Two Learning Contexts:  
A 12-Month Qualitative Study of Undergraduate Students and PK-12 Classroom Teachers

Student Author: Marika Samuelsson

Faculty Mentor(s): Dr. Scott Gartlan

College: Education

Little research exists examining the thoughts, feelings, and perspectives of university professors in the process of developing, implementing, and reflecting on the teaching practices between undergraduate students and PK-12 classroom teachers. This study aimed to correct that by examining a university professor's perspectives over the course of three semesters in two distinct learning contexts: teaching undergraduate students in a science lab and leading in-service PK-12 classroom teachers in professional development seminars. By collecting interview data from the perspective of a professor in these contexts, researchers sought to analyze and understand the relationships between how university professors describe and interpret different learning environments. Using a grounded theory research model, three semi-structured interviews were conducted with a university science professor, one student focus group interview made up of four undergraduate students in a science lab, and one teacher focus group interview made up of four PK-12 public school teachers in professional development seminars over the course of twelve months. Qualitative data collected were analyzed in three stages: coding, comparative analysis, and theme identification. A total of 216 codes were generated during data analysis and coding of the three professor interviews. From the coded professor interview data, four preliminary themes emerged: positive learning environment, student engagement, personal relationship, and teacher confidence. Creating an environment in which learners felt safe to ask questions in turn allowed the professor to more easily facilitate discussion and have productive meeting time. Undergraduate student and PK-12 teacher focus group interviews were also analyzed for initial codes, categories, and themes. This study contributed to the knowledge of effective science education by focusing two distinct learning contexts from the professor's perspective. Future research could enhance data triangulation by including robust fieldwork through classroom observations to detect the mechanisms that contribute to a positive learning environment in both contexts.

Title: The Influenza Pandemic of 1918 and its Impact on the Arts in the U.S.

Student Author: Cady Suddeth

Faculty Mentor(s): Dr. Meg Whalen

College: Art and Architecture

In light of the COVID-19 pandemic, arts organizations are faced with a barrage of challenges, and artists are attempting to create and share their work in new ways. A century ago, the world endured an even deadlier public health crisis. The Influenza Pandemic of 1918 spread throughout the world at a devastating rate from the spring of 1918 to the summer of 1919. Over 600,000 US citizens are estimated to have succumbed to this silent killer. The epidemic has been vastly underrepresented in historical accounts. While it must have made profound impacts on culture, the economy, and daily life, it has been overshadowed by two world wars and the Great Depression. Visual and performing arts tend to reflect the culture of the time but until recently there has been little effort to understand the arts landscape during the influenza pandemic. The goal of this paper is to explore the available literature and uncover the impact that the flu had on music, visual arts, and theater throughout various cities in the US. The research included analyzing eye witness accounts depicting life in the shadow of the Influenza outbreak and archival newspaper articles and collections. Research also included secondary accounts on the flu outbreak and its impacts on daily life. Key works of art and music in response to the disease were also explored and analyzed. This research on the Influenza Pandemic of 1918 and its impact on the arts and their survival could help those involved in the arts navigate through the various hardships they are currently facing.

# Charlotte Research Scholars

Title: An Examination of Cluster Grouping and AIG Certified Middle School Teachers

Student Author: Alexandria Airhart

Faculty Mentor(s): Dr. Cindy Gilson

College: Education

Cluster grouping is a research-based differentiation strategy that groups students into classrooms based on their range of academics. Clustering in middle school allows for Academically or Intellectually Gifted (AIG) students to receive daily advanced instruction if they have a teacher who is certified in Gifted Education and is able to meet and understand the needs of this diverse population. Clustering AIG students with AIG-licensed general education teachers or with those who have met the requirements of the AIG plan is a recommended strategy from Unpacking the NC AIG Program Standards for counties to implement to address Standard 4 Practice D in the NC AIG District Plans. This study explores the relationship between the number of districts that require cluster grouping and the number of districts that require teachers of the cluster groups to have the AIG training. The purpose of this study is to explore five counties AIG District plans in the Southwest District of North Carolina to deepen my understanding of cluster grouping as described in the 2019-2022 NC AIG District Plans. Preliminary data analysis shows that the five counties examined all address clustering in middle school classrooms. All counties except for one county require the teacher of AIG clustered classrooms to be certified or to be pursuing a certification in AIG. Important themes that might emerge from this study may relate to the nuances about differentiation of curriculum and instruction within cluster grouping. The importance of this study is that the findings may help others to understand the value of cluster grouping and having teachers certified and trained to effectively educate this diverse population.

Title: Charter School and School Segregation

Student Author: Tonantzin Apolinar

Faculty Mentor(s): Dr. Jason Giersch

College: Liberal Arts and Sciences

Charter schools in some states have been found to be more segregated than their Traditional Public Schools. The purpose of this research is to investigate the causation of segregation within charter schools in relation to the laws governing these schools and state's political culture. The main questions concerning this research are: What features of state laws encourage segregation? What variables are contributing to the increase of segregation? What can be done to decrease segregation in charter schools? To complete this research, we used quantitative data from 38 states in 2015-2016 school year to examine patterns of segregation through the distribution of socioeconomic and racial groups among students. In addition to this data, to understand state laws, we used Center for Education Reform's Scorecard from 2012 and other qualitative data reflecting each state's political culture. Qualitative data from 2012 was better suited for this research as these laws and climate would be reflected upon the 2015-2016 school year. The dependent variable of this study is segregation in schools, which can be found through the difference of standard deviations in percent White and FRL (Free and Reduced Lunch) in charter schools and traditional public schools. The independent variables include state laws and political culture, such as operational autonomy, teacher union, and political affiliation. To find patterns of segregation among the data, the method of regression analysis was used to find statistically significant relationships of independent variables, which would be the variables affecting segregation within schools. The study and findings suggest that states have different laws governing charters and political culture, which such variables could ultimately be encouraging school segregation.

Title: A Study of Imidazole and Pyrimidine Thione and Selone Copper Complexes and Their Antimicrobial Properties

Student Author: Joanne Azar

Faculty Mentor(s): Dr. Daniel Rabinovich

College: Liberal Arts and Sciences

The versatility of transition metals, particularly in biochemistry and medicine, encourages scientists to research coordination complexes with heterocyclic thiones and selones. Since metallic compounds exist as ions in aqueous environments, they exhibit numerous unique characteristics that make them particularly useful in long-term therapeutic drug development, from redox activity to variable coordination chemistry. Like most other transition metals, copper shows these properties because it acts as a Lewis acid that can accept electrons and form different complexes. Copper complexes were found to be easily prepared in a relatively high yield (between 63% and 95%) and could adopt numerous coordination modes. The copper complexes researched in this literature study were typically crystallized so the structures could be characterized by X-ray crystallography, Infrared spectroscopy (IR), or  $^1\text{H}$  and  $^{13}\text{C}$  Nuclear Magnetic Resonance spectroscopy. Results of multiple studies showed that changing the substituents on the heterocyclic ring would alter the strengths and angles of Cu-Se/S bonds. Most studies were conducted on imidazole and pyrimidine thione copper complexes because they are more easily synthesized than their selone counterparts. Although there is generally less research on selone metal complexes, it has been found that selenium coordinated copper complexes could have major biological significance due to their strong negative reduction potentials. Selone complexes have been observed to be particularly helpful in preventing copper-mediated DNA damage, the root of many neurological disorders. Identifying the structural differences between thione and selone complexes helps scientists distinguish between important properties that can be used in future applications. Throughout this literature review, imidazole and pyrimidine thione and selone copper complexes were compared and analyzed for their purpose in therapeutic drug treatments, cancer treatments, and other forms of antimicrobial activity.

Title: An Analysis of Ray Tracing using VRI, VRBI, and Other Similar Approaches

Student Author: Timothy "Drake" Blalock

Faculty Mentor(s): Dr. Kosta Falaggis

College: Engineering

Light can be described through a variety of physical models. The simplest being ray optics, followed by scalar wave-optics, and vectorial wave-optics. The next level of complication is quantum optics. The more complicated and in depth the approach, the more complicated the calculations associated with it are. It is extremely simple to trace rays through an optical system, but some camera lenses can make this more complicated because of the errors on the face of the lens that interrupt light. Vectorial Ray Integral (VRI) uses "vectorial wave-optics rays" for free-space, and Vectorial Ray Based Integral (VRBI) uses the same method but through lenses. VRBI is a kind of hybrid model between ray-optics and vectorial wave-effects. Due to their similarities, could one use VRI and VRBI in order to accurately model an optical system through a lens? To answer this question a variety of programs can be used to help model an optical system using VRBI, VRI, and similar approaches. Using MatLab and Code V to attempt to simulate these systems, no conclusive results have yet been determined.



Title: Thermotolerance Resistance in Tomato Plants

Student Author: Rachel Blanding

Faculty Mentor(s): Dr. Robert Reid

College: Computing and Informatics

Global warming is the rise of the earth's temperature due to greenhouse gases and carbon dioxide emissions in the air. If the emission rate does not decrease in the upcoming years then the global temperature will increase. As a result, the world will experience severe heatwaves and changes in precipitation patterns, which can negatively affect the production of produce. Up to one-half of all plants may become at risk of extinction if these global warming changes persist. One of the issues associated with global warming is the reproduction and survival of plants. If produce around the world is not able to survive and reproduce, then many animals and humans will not be able to obtain the nutrition they need. Many animals will die from starvation and others will suffer from malnutrition. This can result in a lowered fitness and changes in offspring. Several studies have focused on determining which DNA sequencing in at-risk plants will make them more tolerant to higher temperatures through survival and reproduction. This study focused on finding genes that are expressed in tomato plants that give them the ability to survive stress conditions like super-optimal temperatures. Tomato genes were extracted and analyzed for the ability to reproduce and survive in optimal and super-optimal temperatures. Pollen tube growth in the pistil was observed and then certain pathways were analyzed for changes in these conditions. According to Yamamoto et al, the pollen development in tomatoes becomes flawed when exposed to higher than optimal temperatures. These temperatures then affect the protein structure of plants and lead to a decreased fertility rate (Yamamoto, et al., 1979-1990). An increase in flavonoids occurs in relationship to super-optimal temperatures in tomato plants (Neeta, Mohan, et al., 2020). Software tools are used to create pathways and to predict how certain DNA sequencing will react.

Title: Collagen Deposition in the in Vivo Mammary 4T1 Tumor Model

Student Author: Kathryn Brinegar

Faculty Mentor(s): Dr. Didier Dréau

College: Liberal Arts and Sciences

Breast cancer is the second leading cancer-related cause of death for women living in the United States and will affect about 1 in 8 of all women in the United States. Fibrosis i.e., collagen deposition is an independent factor associated with a poor prognosis. Local inflammation, mainly through cytokine secretions, and associated fibrosis lead to a microenvironment that favors tumor growth. In particular, inflammasome activation promoted pro-inflammatory cytokine secretion and local inflammation. The in vivo combined effects of treatment with NLRP3-specific inflammasome inhibitor MCC950 and of 5-FU on tumor growth and tumor fibrosis was assessed. Briefly, Balb/c female immunocompetent mice implanted orthotopically with the following: 4T1 tumor cells alone, with 1/5 J774 cells, or with 1/5 RAW cells. They were administered either saline, MCC950, or the combination of MCC950 and 5-FU. After 35 days of treatment, the tumors were harvested, weighted, and stained with a Masson Trichrome stain and specific anti-Caspase 3 to assess collagen deposition. Tumor collagen was assessed following color deconvolution using Image J software and the collagen compared between treatment groups. Results highlighting Trichrome stain and collagen deposition in the different treatment groups including the combined treatment of MCC950 & 5-FU are presented.

Title: Politics as Usual: U.S. Immigration Politics During the COVID-19 Pandemic

Student Author: Heaven Brown

Faculty Mentor(s): Dr. Beth Elise Whitaker

College: Liberal Arts and Sciences

The United States has been widely ineffective in coordinating a public health response to limit the spread of COVID-19 and in providing economic relief amidst a free-falling economy. State governments have been vital to coordinating resources to fill the gaps in the fragmented federal response. The Trump administration's anti-immigrant agenda has left immigrant communities across the country without safety nets by excluding immigrants from social welfare programs and enacting stringent border restrictions. With many states dependent upon immigrant workers for economic stability and an effective public health response, state officials are forced to address immigration issues, including how to support and protect immigrant essential workers whose presence influences both the death toll and recovery of a weakened economy. State responses have also been inconsistent; California has been the only state to coordinate a state-wide response, allotting \$75 million to provide economic relief to undocumented immigrant residents. Localities within states with large immigrant populations have enacted local policies to address economic, health, and safety concerns of vulnerable undocumented communities. Why did California respond to immigrant exclusions in the federal COVID-19 response at the state-wide level, while New York did not? Utilizing a comparative case analysis of California and New York this paper will analyze state responses to the United States' federal COVID-19 response, looking specifically at how these states responded to immigrant exclusions in the federal response, including unemployment, border closings, and restrictions on legal immigration. By examining online media sources, state legislation, and public officials' statements, I seek to address the implications of state COVID-19 responses and how policy has impacted various immigrant communities. By comparing economic, health, demographic factors in California to New York, I will identify the factors that have resulted in the contrasting approaches these states have taken to address immigrant exclusions in the federal response.

Title: An Analog Technique for Studying Molecular Hydrodynamic Behavior Using Vibrated Grain Piles

Student Author: Philip T Brown

Faculty Mentor(s): Dr. Jerry Dahlberg, Dr. Russell Keanini, and Dr. Peter Tkacik

College: Engineering

Present methods of studying molecular hydrodynamic systems include light scattering, molecular dynamic simulations, and neutron scattering. Researchers at UNC Charlotte have recently developed an analog technique, using vibrated grain beds, as an alternative method for studying molecular hydrodynamic systems. Unlike other methods, this macroscopic analog directly observes molecular flow and particle interactions. Specifically, that vibrated grain beds exhibit many of the same dynamical properties known and predicted in dense liquid-like molecular systems. This project will test a central question: To what extent do vibrated grain beds mimic the dynamical structure of dense molecular hydrodynamic systems? Continuum-scale response of non-polar fluids to scattered light and neutron probe beams consists of: i) two counter-propagating (weakly damped) sound waves, ii) two diffusing pockets of rotating fluid (produced by probe-induced shear stresses), and iii) a diffusing pocket of slightly heated fluid. The experimental signature of these responses emerges from the Dynamic Structure Factor, the Fourier transform of experimentally measured fluid density variations. In contrast to fluid density variations measured in light and neutron scattering experiments, the present project will use experimentally measured, vibration-induced variations in grain velocity to perform the same diagnostic determination of the Dynamic Structure Factor for vibration-driven grain systems. Based on the demonstrated dynamical equivalences between molecular hydrodynamic and vibrated grain systems already observed by researchers at UNC Charlotte, it is anticipated that the same collective dynamics observed in the former will be found in the latter. If this turns out to be true, then the case for using vibrated grain beds as predictive analogs for studying molecular hydrodynamic systems will be significantly strengthened.

Title: Function and Mechanisms of APOBEC3 in Genome Integrity and Cancer Biology

Student Author: Brianna Bush

Faculty Mentor(s): Dr. Shan Yan

College: Liberal Arts and Sciences

The genome of cells is constantly exposed to damage from endogenous resources such as oxidative stress or environmental toxins, leading to various different types of DNA lesions. Cells have evolved several stress response pathways including DNA repair and DNA damage response pathways to maintain genome integrity. Defects in DNA repair and DDR pathways have been implicated in pathologies of human diseases such as cancer. The APOBEC3 family of cytosine deaminases can turn cytosine bases into uracil bases, leading to 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. In this review we will examine the diversity of seven different APOBEC3 genes (A3A-A3G) and their functional domains. We will also study the evolution of APOBEC 3 genes in different mammals (rodents, primates, and humans) and discuss how they adapt to survival advantages. Whereas APOBEC3 proteins are antiviral factors that developed to protect humans and mammals from viruses, we will focus on how DNA lesions induced by APOBEC3 are repaired and its 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.

Title: An Examination of the Interactions Between Gender Identity and Business PAC Funding for Members of Congress

Student Author: Patrick Byrd

Faculty Mentor(s): Dr. Eric Heberlig

College: Liberal Arts and Sciences

Over the last few decades, Congress has grown increasingly diverse as more women and minorities have begun campaigns infiltrating the patriarchal field of politics. With this new social and political shift, fundraising has become a point of focus in order to achieve significant outreach and coverage of constituents. A diverse Congress can create altered goals within fundraising and the way that fundraising is secured to ensure that corporate interests stay prioritized. These priorities focus on special committees that are primarily dominated by men in Congress. Due to those changes in Congress, women are likely to receive less funding than men from access-oriented business PACs? Examining business PAC contributions from 1980-2014, we will test hypotheses as to whether there is a gender discrepancy regarding the allocation of business PAC funding and whether there is a significant difference between the legislative effectiveness score of Congresswomen and Congressmen that explains the contrast in funding. The funding allocation is thought to be affected by Legislative effectiveness as business PACs will be more likely to supply funding to members of Congress that can pass legislation. We will use Carol Gilligan's gender difference theory (1982) to understand gendered socialization and how it affects the perceptions of women in areas of power. This perception causes women to be passed over or overlooked during committee hearings as Kathlene (1994) theorized. With men receiving more recognition and commendation for their position within committees, business PACs are more likely to allocate funds towards Congressmen who are statistically more likely to be present in committees that hold higher legislative power over corporate restrictions. The data concludes that there is a significant difference between Congressmen and Congresswomen in business PAC contributions. My analysis shows, however, that there is not a significant difference regarding the Legislative Effectiveness Score and gender.

Title: Posttraumatic Growth May Differentially Influence Mental and Physical Health Following Stressful Life Events: Investigating the Effect of Stressful Life Event Characteristics

Student Author: Sydney Campbell

Faculty Mentor(s): Dr. Jeanette Bennett

College: Liberal Arts and Sciences

Stressful or traumatic life events 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 may be experienced as a result of struggling with traumatic life circumstances, not just a stressful event, and may reduce depressive symptoms. In response to heightened stress, individuals can exhibit prolonged physiological system activation that can negatively affect their health and increase their likelihood of developing psychiatric problems. Life events can be stressful; however only specific events can be labeled as traumatic, leaving a gap on whether stressful life events, in general, can lead to posttraumatic growth and improve health outcomes. This study examines how event type, traumatic or stressful, and time since the event may change how perception of PTG and health are related following a stressful life event. We predict a 3-way interaction among PTG, event type and time since the event affecting current health. Specifically, individuals who experienced a traumatic life event in the past will show the strongest positive relationship between PTG and health, while individuals who experienced a stressful life event recently will show no relationship between PTG and health. For the other two groups – recent traumatic event and past stressful life event – we expect the relationship between PTG and health to fall in-between these two extremes. Over 500 college students completed an online survey via Qualtrics, answering questions about stressful life events they had experienced, focusing on the most stressful event, and their perception on the level of PTG they had experienced since the event. Mental and physical health were assessed as depressive symptoms and ability to engage in normal daily activities, respectively.

Title: The Role of Gold Heterocyclic Thione and Selone Complexes in Cancer Research

Student Author: Justin Castillo

Faculty Mentor(s): Dr. Daniel Rabinovich

College: Liberal Arts and Sciences

Gold coordination complexes with heterocyclic thione (C=S) and selone (C=Se) ligands are investigated for their potential (or reported) use in antimicrobial and antitumor applications. More specifically, this literature survey focuses on 5- and 6-membered heterocyclic systems derived from imidazole and pyrimidine, respectively. In turn, gold, a transition metal, has been widely used in the medical field to treat a variety of diseases and conditions like rheumatoid arthritis, smallpox, and measles; gold complexes are even presently being evaluated for their potential in treating acute forms of asthma and pemphigus. Gold(I) and gold (III) complexes, specifically, have been shown to exhibit anticancer properties. Gold(I) complexes have been shown to be effective in treating cancers from non-solid tumors, like melanoma and leukemia, but were shown to be ineffective against cancers with solid tumors and harness cardiotoxic properties. Gold(III) complexes, on the other hand, have demonstrated anticancer properties alternative to cisplatin, the most common platinum-based compound used for chemotherapy, due to its cytotoxic properties with degrees of selectivity to prevent surrounding cell death. Gold complexes were synthesized to produce a 50-86% yield depending on the corresponding ligands, and analyzed through  $^1\text{H}$  and  $^{13}\text{C}$  Nuclear Magnetic Resonance (NMR) spectroscopy, mass spectrometry, and other techniques. Due to the occurrence of the COVID-19 pandemic, data was not able to be obtained from laboratory tests and analyses; therefore, this report comprises a literature review of peer-reviewed articles about gold heterocyclic thione and selone complexes and its applications contributing to anticancer drugs in an effort to provide a nuanced understanding of and an alternative to existing chemotherapy drugs.



Title: Literature Review and Study of Imidazole Thione and Selone Silver Complexes

Student Author: Thomas Cole

Faculty Mentor(s): Dr. Tom Schmedake

College: Liberal Arts and Sciences

The coordination chemistry of imidazole thione and selone compounds with transition metals has generated immense research interest due to the large range of applications such compounds exhibit, including reducing heavy metal toxicity, catalysis, and the preparation of antimicrobial and anti-tumor drugs. In addition, the antioxidant properties of many of these compounds stems from the presence of redox-active metals that prevent hydroxyl radical-mediated DNA damage and, in general, their ability to interact with hydrogen peroxide or other reactive oxygen species. Although the coordination chemistry of thiones is fairly well established, very few studies have described selone metal complexes, especially with second and third row d-block metals. For the specific case of silver, we have found that these complexes are easily prepared in high yield and typically display characteristics of good solubility, simple spectroscopic features in solution, and good crystallinity in the solid state. They are characterized analytically and spectroscopically, through  $^1\text{H}$  and  $^{13}\text{C}$  Nuclear Magnetic Resonance (NMR) as well as infrared (IR) spectroscopies. Some of their molecular structures have been confirmed by single crystal X-ray diffraction and many different relationships of bond angles and lengths are analyzed in order to compare the effect of a thione vs. selone when bonded to silver (Ag-S-C vs. Ag-Se-C, S-C-N vs. Se-C-N, etc.). The biological activity of silver complexes supported by related N-heterocyclic carbene (NHC) ligands has been investigated in recent years and will be contrasted with that of any analogues containing thione and selone ligands. Thus, this report comprises a review of silver complexes containing N-heterocyclic thione and selone ligands in order to gain an understanding of possible new applications, particularly as anti-tumor, antioxidant, and antimicrobial agents.

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

Student Author: Michael Coston

Faculty Mentor(s): Dr. Jay Grymes

College: Art and Architecture

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.

Title: Examining Teachers Perceptions of and Use of Inquiry in Math

Student Author: Mario Cuellar

Faculty Mentor(s): Dr. Drew Polly

College: Education

Research has found that teachers' beliefs influence their enacted pedagogies, including teachers' use of formative assessment practices. Further, studies have also found that when teachers ultimately teach standards and enact pedagogies in ways that are shaped by their influences and experiences with mathematics. Leveraging constructivism as a theoretical framework this study is grounded in the idea that teachers' learning is constructed through meaningful experiences. The purpose of this study is to examine elementary school level teachers' perceptions of and use of formative assessment in mathematics. Specifically, this study examines the research questions: 1) What types of resources and processes do teachers use to conduct a formative assessment in mathematics? 2) What are teachers' perceptions of their resources and processes related to formative assessment in mathematics? Research was and continues to be collected through the use of an online survey sent out to practicing elementary school teachers in North Carolina with a focus on school districts in the Charlotte area. Follow-up interviews may also be conducted to gather and gain a perspective into the classroom and minds of selected teachers. Data analysis of numerical survey data will include descriptive statistics. Data analysis of written comments will include thematic analysis. The survey indicates that teachers are participating in formative assessment practices using a variety of resources. This study will provide a gauge of practicing elementary mathematics teachers enacted formative assessment practices. The study will also provide teacher educators and professional developers with information to guide future work related to effective teaching strategies related to formative assessment.

Title: Statistical Analysis of Risk factors for the Incubation Time of COVID-19

Student Author: Elvis Dang

Faculty Mentor(s): Dr. Qingning Zhou

College: Computing and Informatics

To combat the COVID-19 pandemic, we look into the virus' incubation time, defined as the duration between infection and symptom onset. A reliable estimate of the incubation time helps to determine the length of quarantine and help contain the pandemic. Although COVID-19 has been extensively studied since its outbreak there is no known studies on risk factors of its incubation time. The purpose of our research is to study the association of different covariates with the incubation time of COVID-19. If certain factors are found to be associated with the incubation time, the standard quarantine duration of 14 days may be shortened or lengthened for a specific group to help better control the pandemic. We have obtained data from the MOBS LAB's official website, where they have recorded data from the first three months of the pandemic that includes key variables, such as symptom onset, exposure dates, location, gender, and age. We have also integrated the average temperature for every observation by joining a Kaggle's world's monthly temperature average dataset by the patient's location and reporting month. The covariates considered in our analysis include age, gender, and temperature. The incubation time of each patient is approximated by the duration between the midpoint of the exposure period and symptom onset. We have made visuals, such as histograms and scatterplots, to understand the distribution of the incubation time and its relationship with each covariate. We have also fitted the Cox proportional hazards model for the incubation time to see the hazard ratio of each covariate. The preliminary results of our studies show that the median incubation time is about 4 days and similar in subgroups defined by covariates. Results from the Cox proportional hazards model suggest that older patients and cooler temperatures of location are associated with longer incubation times, but marginal.

Title: Cambridge and Women's Education: Navigating Gender Norms in the Late Nineteenth Century

Student Author: Olivia Dobbs

Faculty Mentor(s): Dr. Alan Rauch

College: Liberal Arts and Sciences

In the late Victorian era, British women were increasingly offered opportunities to further their education. Social reforms helped solidify their primary and secondary educations, while universities began to establish programs specifically for women. More specifically, Cambridge opened up two women's colleges, Girton and Newnham, in 1869 and 1871, respectively. Multiple women established successful college careers at these schools. For example, Philippa Fawcett, a student at Newnham, scored higher than her male peers on the final mathematics examination known as the Tripos, while Charlotte Angas Scott used her experiences as a student at Girton to help establish the mathematics department at a renowned women's college, Bryn Mawr, in the United States. However, these intellectual women often found themselves limited in what they could accomplish. Girton and Newnham Colleges were not officially recognized by the University of Cambridge, so their female students did not receive full degrees, but honorary certificates. Furthermore, male professors and lecturers often designated their female students as secondary assistants and discouraged them from pursuing their own research without the guidance of a male figure such as themselves. These limitations mainly arose due to existing gender norms, which dictated that women did not share the same intellectual capabilities as their male counterparts and should thus refrain from professions that require a college education. Nonetheless, due to their careful navigation of certain traditional gender roles, Cambridge alumni such as Fawcett and Scott were able to promote and inspire the education of other women through their collegiate accomplishments, guidance, and literature.

Title: Modeling an Optical Feedback System for Infrared Laser Sealing of Blood Vessels

Student Author: Julian V. Doe

Faculty Mentor(s): Dr. Nathaniel M. Fried

College: Liberal Arts and Sciences

Radiofrequency (RF) and ultrasonic devices (US) expedite hemostasis of vascular tissues during surgical procedures. Device limitations include significant thermal spread and high device jaw temperatures which delay procedures. An alternative, optical approach utilizing a high power, infrared (IR) diode laser for sealing of blood vessels has shown promising results during preliminary ex vivo tissue and in vivo animal studies. RF and US devices currently utilize a real-time feedback system for indication of vascular tissue coagulation. This paper will explore the possibility of an optical real-time coagulation feedback system for high power IR laser ligation of blood vessels. Light scattering increases when tissue is transformed from its native to thermally denatured state. This reduced transmission may potentially serve as feedback to indicate when thermal coagulation is complete. A Beer-Lambert's law model and a Monte Carlo model will be implemented to determine the intensity disruption through native and coagulated tissue. To start, scattering and absorption coefficients of native and denatured human aortas at various near-infrared wavelengths (1300, 1320, 1450, 1470, and 1500) were interpolated from a paper concerning light dosimetry using a shape-preserving piecewise cubic interpolation. These values were then implemented within a Beer-Lambert's law model which returned the IR diode laser's transmittance and absorbance throughout 0.04 cm of tissue. The Monte Carlo model was then implemented using the discovered values to reveal the photon transport in the tissues. It's expected that by using these two models, we will have a proper understanding of when thermal coagulation is complete and thus, an applicable optical feedback system.

Title: Adding Sensor Peripherals to a ROS Enabled All-Terrain Vehicle

Student Author: Gabriel Van Dreel

Faculty Mentor(s): Dr. James Conrad

College: Engineering

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. A significant amount of research has been conducted on the development of autonomous vehicles for conventional roadways, but relatively little research has addressed autonomous vehicle operation that may require detours or off-road paths such as with the presence of a fallen tree on a road. One potential cost-effective solution for addressing the design of 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 (UNCC) 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.

Title: An Examination of the Seneca Falls Convention in the Context of the International Revolutionary Moments of 1848.

Student Author: Allyson Everage

Faculty Mentor(s): Dr. Christine Haynes

College: Liberal Arts and Sciences

August 2020 marks the one-hundred-year anniversary of the ratification of the 19th amendment guaranteeing women's suffrage within the United States. This ratification was the culmination of the women's suffrage movement, which began with the Seneca Falls Convention of 1848. During this meeting for women's rights, activists gathered in the local Wesleyan Chapel in Seneca Falls, New York, to discuss equality for women. This paved the way for women's suffrage and equality in the United States, proving to be a significant development during the nineteenth century. Historians have determined that the Seneca Falls Convention was a major turning point in the fight for women's rights, providing a starting point for the women's suffrage movement in the United States through the creation of the Declaration of Sentiments. This project will place the Seneca Falls Convention in the context of the international revolutionary moments of 1848, when people across Europe, the Caribbean, and elsewhere fought for their civil and political rights. By examining the Declaration of Sentiments, other historical documents within the American Woman Suffrage Association Collection and publications by prominent figures at the Seneca Falls Convention such as Carrie Chapman Catt, Elizabeth Cady Stanton, and Lucretia Mott, this project will explicate the history of the convention, in international context. The final product of this project will be a virtual timeline outlining the major developments, leading figures, other civil and political rights movements, and documents involved in the birth of women's suffrage in the United States within the revolutionary movements of 1848.



Title: Exploring How Young Ethnic Minority Women Communicate Risk Behavior on Social Media

Student Author: Shayna Farris

Faculty Mentor(s): Dr. Erika Montanaro

College: Liberal Arts and Sciences

Research indicates an overwhelming majority (88%) of 18-29 year olds use any form of social media (e.g., Facebook, Instagram, etc.; Pew Research Center, 2018). Daily use has dramatically changed the way young adults have communicated a host of health behaviors. Specifically, 54% of profiles were found to contain 1 or more references to a high-risk behavior (e.g. drug and alcohol use, risky sexual behavior; Cookingham & Ryan, 2015). Furthermore, evidence suggests that those who engage in risky behavior offline also engage in risky behavior online (Baumgartner et al., 2012). The current study explores how risk behavior is presented via social media, specifically, Instagram content curated by young ethnic minority women. While social networking sites like Facebook and Myspace have been examined, frequently used sites like Instagram have not been examined thoroughly to understand how risk behavior is communicated (Vannucci et al., 2020; Couture, 2020). This has resulted in research lagging behind rapidly evolving youth trends. Additionally, young ethnic minority women remain an understudied demographic in this literature (Vannucci et al., 2020; Couture, 2020). The current study recruited 100 young ethnic minority females (e.g., Black/African American, Hispanic, American Indian, Asian, and/or Pacific Islander) ranging in age from 18-25. Participants completed sexual behavior and substance use questionnaires. Instagram posts were gathered from the preceding six month period prior to study participation. Influenced by grounded theory, coding schemes focused on risk behavior will be used to categorize the content shared via Instagram. Descriptive statistics will be used to summarize the survey data (e.g., self-reported drug and alcohol use, demographic information). Analyses are expected to be complete by August 2020. By understanding how risk behavior is communicated via social media, researchers can better utilize it as a mechanism to implement more effective interventions among young ethnic minority women.

Title: Jeffrey Dahmer: A Comparison of the Case to the Research Literature

Student Author: Destiny Fulton

Faculty Mentor(s): Dr. Charisse Coston

College: Liberal Arts and Sciences

Jeffrey Dahmer, also known as the Milwaukee Monster and/or Milwaukee Cannibal, is notorious for being an American serial sex killer during the years of 1978-1991. Dahmer is responsible for the killing and dismemberment of 17 males (includes both younger boys and older men). Dahmer chose to engage males as his primary victims because he was homosexual, and therefore his victims were homosexual. Jeffrey Dahmer had a bit of a sinister childhood. He grew up in a household that was filled with domestic violence from his father. This research builds upon earlier research about serial murderers and how their offenses could have been prevented. It also examines the similarities and differences within the literature to assist in exposing patterns and similar typologies among serial sex murderers, although there is no one 'true' typology. This study will discuss the case of Jeffrey Dahmer in its entirety, ranging from Dahmer's early childhood life, up until his last victim in the year of 1991. The method used in this study was a literature examination using compiled sources of earlier research and scholarly articles to accurately compare and contrast to the literature. Due to the specific method of research, there are no new results and/or findings, but instead this study answers the 'so what' question of why these offenders were not met with different interventions implemented by the criminal justice system, medical professionals, social workers, and the family dynamic of these serial sex killers, such as Jeffrey Dahmer, that could have stopped the killings sooner, as well as why serial sex murderers choose to indulge themselves in this combination of sexual and sadistic pleasures.

Title: Southern Louisiana Marsh Food Webs: Top Predator Diets in Salt Marshes

Student Author: Christopher Garcia

Faculty Mentor(s): Dr. Paola Lopez-Duarte

College: Liberal Arts and Sciences

Salt marshes are transitional zones in which terrestrial and aquatic food webs intersect. The purpose of this study was to analyze dietary biomarker data of red drum, a top predator fish, to determine whether their diets are mostly derived from aquatic or terrestrial sources. As juvenile fish, red drum utilize marshes as nursery habitats and move to deeper water as they mature. Our objectives were (1) to establish the proportion of terrestrial vs. aquatic components in the diets of red drum in Louisiana salt marshes and (2) to compare their diets to those of red drum collected in marshes that were affected by the 2010 BP Oil Spill. We analyzed dietary biomarker data ( $\delta^{15}\text{N}$  and  $\delta^{13}\text{C}$ ) from food web samples collected in southern Louisiana in 2015. We identified data from the predator of interest (red drum), and other members of the salt marsh food web (striped mullet, blue crab, fiddler crab, Gulf killifish, phytoplankton, and cordgrass) collected at oiled and unoled marshes and different marsh sub-habitats (creek, ponds, and edges). Data for both juvenile (38-49 cm) and adult (62-74 cm) red drum were available. Preliminary results indicate that the dietary signatures of blue crab, striped mullet and Gulf killifish overlap, indicate that they likely share food resources themselves. Red drum has the highest  $\delta^{15}\text{N}$  levels in the dataset, placing them at the top of our food web. The next step is to compare red drum diets across marsh sub-habitats and sites. If there are lingering oil effects, we would expect these top predators to rely on prey items that are more terrestrial than aquatic. In terms of sub-habitat, we would expect the red drum to rely on feeding in the pond and creek sub-habitats due to the edge being more heavily smothered.

Title: A Taste of Paris: Alcohol Consumption in Provincial France as Portrayed in Balzac's *La Muse du Département* and Flaubert's *Madame Bovary*

Student Author: Kellie Giordano

Faculty Mentor(s): Dr. Christine Haynes

College: Liberal Arts and Sciences

Popular literature published during France's July Monarchy (1830-1848) illustrates how and why French provincials consumed alcohol amidst the fluid political, economic, and social culture of the early nineteenth century, to which consumption habits were often in flux. The provincial desire for alcohol mirrored the widespread drinking culture of Paris. During the nineteenth century, conspicuous consumption, in particular of wine and liquor, became a prevalent external signifier of wealth that spread to the countryside. For many provincials, especially those in the emerging bourgeoisie, alcohol became an integral part of culture in the province's café, cabarets, and theater, to exhibit their status, and ultimately drinking acted as a vehicle for social mobility. To analyze these consumption trends, this work examines two novels, *La Muse du Département* (1837) by Honoré de Balzac and *Madame Bovary* (1855) by Gustave Flaubert, in tandem with historical records from the provincial towns of Sancerre and Rouen, where each respective novel is set. Through the close reading of these heavily-circulated novels, as well as archived travel guides to Sancerre and Rouen and alcohol treatises, this work elucidates the drinking culture that swept provincial France during the early nineteenth century. A secondary purpose of this study is to suggest that romantic and realist literature catalyzed this greater popularity of alcohol and luxury commodities by the mid-century, as the plots of these novels supported breaking one's prescribed role in society and embracing consumption for social status, thus, drinking and alcohol consumption became one of the principle means by which sociability was shaped in nineteenth century France.

Title: Phil Freelon's Effects on Black Culture and Activism

Student Author: Nicholas Jensen

Faculty Mentor(s): Dr. Emily Makas

College: Art and Architecture

Phil Freelon was explicitly intentional about the types of commissions he accepted. In many ways Freelon's work was a form of activism, he once said "I don't do casinos or prisons; I like to do projects that enhance the lives of everyday people, like campus buildings, libraries, museums and government buildings." Freelon dedicated his work to enriching communities, especially Black communities through the curation of Black history and culture in museums and cultural centers. These projects were intended to represent, activate, and enrich the Black communities in which they were built. I will explore how and to what extent these projects have been successful at achieving these objectives. By analyzing news reports and reviews, I intend to investigate the reception of these museums by Black people, by non-Black people of color, and by white people. Furthermore, I will look into the programming done at these museums to examine their efforts in community outreach within and beyond the Black community, in the hopes to see if and how these museums have curated or centered activism. I will focus on museums which were completed more than 5 years ago so the patterns of the museum's programming are established. The following projects meet the stated requirements...

- Museum of the African Diaspora
- Reginald F. Lewis Museum
- Harvey B. Gantt Center for African-American Arts + Culture
- International Civil Rights Center and Museum
- National Center for Civil and Human Rights

I am going to include the National Museum of African American History and Culture due to the museum's national and international importance due to its inclusion as a Smithsonian Institution museum. Through looking at these factors I intend to draw a conclusion on the effects of Freelon's projects on Black representation and activism in their respective communities.

Title: Identification and Organization of Proteins Involved in the Assembly of Complex Bacterial Polysaccharides

Student Author: Taylor Jones

Faculty Mentor(s): Dr. A. Suzanne Boyd

College: Health and Human Services

Polysaccharides are key components of bacterial surfaces that give bacteria important defining characteristics, such as virulence or adaptability. Though prior research has shown the importance of such sugars in bacteria survival, host interactions, vaccines, and manufacturing materials, the research struggles to organize their functions, production, and composition that is useful for in vitro use. The production of bacterial polysaccharides using glycosyltransferases (GTs) on a base unit of bactoprenyl phosphate was examined to gain foundational knowledge of the topic. Specifically, we focused on the production of sugars in capsular polysaccharide pathways (CPS). While there are other pathways involving the addition of sugars to bactoprenyl phosphate for the production of O-antigens and peptidoglycan, the polysaccharides in CPS were documented first to determine the function and use of a capsule as it relates to particular bacteria. A thorough literature review was conducted by examining previous research—discovered through the NCBI Symbol Nomenclature for Glycans resource page—to identify existing bacterial CPS structures, investigate the capsule's functions, and organize the enzymes used for CPS production. To confirm the validity of a GT to transfer a CPS, collected data using HPLC or mass spectrometry was interpreted. We cataloged the relevant initiating GTs, other sugar-adding GTs, and enzyme modifiers associated with CPS into a database. This database organizes GTs by GT family, gene product, transmembrane helix count, and what sugar they transfer to the bactoprenyl phosphate chain. This database will be used in future research to improve existing CPS pathways and characterize new CPS pathways. Furthermore, organizing these pathways promotes the versatility and variation of the material and allows for a holistic overview of the roles they play.

Title: The Use of a Multiple Sclerosis Documentary Film Screening Program of "When We Walk" as an Educational Intervention to Increase Knowledge and Awareness about Multiple Sclerosis and Support Resources

Student Author: Suzanne Jones

Faculty Mentor(s): Dr. Jerry Troutman and Dr. Colleen Eade

College: Liberal Arts and Sciences

Multiple Sclerosis (MS) is an autoimmune disease with no known cure that attacks the protective coverings of nerves which results in a communication malfunction between the body and the central nervous system. Common symptoms include numbness, fatigue, impaired coordination, and muscle spasms. About 1 million adults live with MS in the United States (National Multiple Sclerosis Society [NMSS], 2019). Using a pre-experimental post-test only design, we hypothesized participants who watched (via WebEx) a 2019 documentary film, "When We Walk," about one man's experience with primary progressive MS, followed by a 30 minute panel discussion, will report an increased knowledge level about MS and national, and local resources. Five panelists included two persons living with MS, a NMSS MS Navigator Program representative, UNCC ADA Coordinator, and a local neurologist. The majority of participants were between the ages of 45 to 64 years old (n=10; 71.42%) and included 12 females (85.71%). Participant's race/ethnicity included 2 persons of color and 12 Caucasians. One participant completed trade/technical/vocational training, 4 participants held a Bachelor's degree, Master's degree, or Doctoral degree, respectively, and 1 held a Professional degree. Almost half of the 29 participants (n=14; 48.27%) completed a 24-item post-event confidential electronic survey (Qualtrics). The overwhelming majority of participants (n=13; 92.87%) "agreed" or "strongly agreed" that "participation in the MS documentary screening and panel discussion increased my knowledge of MS and its related symptomatology". All participants (n=14; 100%) "agreed" or "strongly agreed": (1) "participation in the MS film screening and panel discussion increased my knowledge of available resources at UNC Charlotte and the surrounding area" and (2) "the virtual event met my expectations". Twelve participants (92.30%) rated the "When We Walk" film screening and panel experience as "excellent."

Title: Offering Novelty: How North Carolina School Districts Use Enrichment Programs to Expand Course Options for Gifted High School Students

Student Author: Lesli Kathman

Faculty Mentor(s): Dr. Cindy Gilson

College: Education

Enrichment programs have been shown to have academic and socioemotional benefits for adolescents identified as Academically or Intellectually Gifted (AIG). Further, a recent meta-analysis showed that enrichment programs had the most significant influence on academic achievement among high school students (Kim, 2016). However, confidence in those assessments is undermined by a lack of clear definitions. For my qualitative study, I have chosen to define enrichment narrowly as the opportunity to explore novel academic content in a course of study lasting two or more weeks. At the high school level, programs that provide this type of enrichment offer courses as online supplements to the standard curriculum through the North Carolina Virtual Public School (NCVPS), or in the context of virtual or residential summer camps. Preliminary analysis of the data set has revealed that three institutions are consistently cited in the 2019-2022 North Carolina AIG District Plans, the primary data source for this research study, in connection with this type of enrichment. These are the North Carolina School and Science and Math, the Governor's School, and the Duke Talent Identification Program. Through content analysis of the AIG plans, I seek to gain a deeper understanding of the partnerships formed between school districts and these institutions, and how these opportunities for enriched coursework are communicated to the families of eligible students. Because there is a documented lack of differentiation for gifted high school students, clarity around enrichment programs as defined in this study could raise awareness and enable parents and teachers to select appropriate enrichment opportunities.



Title: Generating Word Graphs for The Finite Complex Reflection Group

Student Author: Christopher Lamp

Faculty Mentor(s): Dr. Angela Berardinelli

College: Computing and Informatics

In this project, we conduct research to develop an algorithm that will generate accurate word graphs for the finite complex reflection groups  $G(r, p, n)$ . Words and word graphs have been well-studied in the context of finite Coxeter groups, but standard approaches have not yet been developed for finite complex reflection groups. The open-source mathematics computing platform SageMath includes implementations of methods that generate word graphs of Coxeter groups. The algorithms that were used in these methods by SageMath are an accurate representation of the current progress in this research area and were analyzed for inspiration on this project. The currently known algorithms for Coxeter groups, in which all reflections are order two, cannot be directly ported and applied to complex reflection groups, as reflections over the complex numbers may have an arbitrary order. To develop a more general algorithm for  $G(r, p, n)$ , words and word graphs in the symmetric and hyperoctahedral groups, types A and B in the language of Coxeter groups, were examined in great detail first. The core behavior of generators, relations, and words in this context was then compared and contrasted with the behavior in  $G(r, 1, n)$  and ultimately  $G(r, p, n)$ . New code, currently being written in Python, and existing SageMath functionality was combined to implement an algorithm we are constructing. The resulting algorithm will be used to represent and visualize data that can then be evaluated for patterns that could lead to insights concerning these groups and their elements in future research.

Title: Factors Associated with HPV Vaccine Uptake in LGBTQ: A Systematic Review

Student Author: Madeleine Ledenyi

Faculty Mentor(s): Dr. Yuqi Guo

College: Health and Human Services

Purpose: The Human Papillomavirus (HPV) is a sexually- transmitted virus in humans (“Genital HPV Infection,” n.d.). In the United States, there are approximately 79 million males and females infected with HPV (“Genital HPV Infection,” n.d.). On a yearly basis, approximately 20,700 HPV- related cancers are found in women, and 14,100 are found in men (“HPV Diseases and Cancers,” n.d.) Although the LGBTQ population is a sexual minority in the United States, they are disproportionately impacted by HPV. It is important this disparity 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. Method: 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. Results: 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, knowledge of HPV vaccine, and healthcare use. The facilitators of HPV vaccine uptake in LGBTQ populations were lack of insurance, misbelief of HPV, high cost, lack of access to healthcare, and sexual orientation related stigma. Implications: 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.

Title: An Examination of Phil Freelon's Buildings as They Relate to the Ground and his Ideologies of Community and Diversity.

Student Author: Emma Lineberger

Faculty Mentor(s): Dr. Emily Makas

College: Art and Architecture

African American history and culture museums became popular during the second half of the 20th century as Black communities sought to share and celebrate their struggles and triumphs in American history. Phil Freelon's architectural works rose to prominence in the early 2000s through his inclusion of African American culture and experience in the basis of his architectural designs, especially for museums and other projects that centered around Black history and culture. These projects show how he connected ideologies of community involvement and celebrating diversity with his architectural motivations and designs. Freelon's deliberate choices of color and material in his works are the most apparent intersection of these ideas, but close examination and further research into how his buildings relate to their contexts will also provide insight into how Freelon designed community involvement and activism into the heart of his designs. By analyzing plans and sections of Freelon's museum building designs and by reviewing secondary literature resources, I will examine how Phil Freelon uses the site and the street conditions to inform the design and how these relate to the surrounding community. Context will be a key component in this research as the size, neighborhood, nearby spaces and business of the site will influence the different approaches to integrating this idea of community and activism into the design. I will question how historic neighborhoods and preserved historic buildings affect the use of public engagement at the street level compared to projects in busy, downtown areas. I will also question the kinds of façade and exterior spaces lead to ideas about community access and engagement as it relates to the physical building and the specific museum programs.

Title: GFP-Atg8 Processing Assay Protocol

Student Author: Alyssa Lucero

Faculty Mentor(s): Dr. Chi

College: Liberal Arts and Sciences

Autophagy is the catabolic process of cellular self-eating, which can either be initiated by environmental signals such as starvation or by natural occurring cellular turnover. Unneeded or damaged cellular components are sequestered as cargo into unique double-membrane vesicles called autophagosomes that fuse to the cell's degradative organelle, the lysosome in animal cells or the vacuole in plant and yeast cells. These key steps and the autophagy-related (Atg) proteins that mediate and regulate them are evolutionarily conserved across all autophagy pathways, including starvation-induced bulk autophagy and cargo-selective autophagy pathways. Dysregulation of autophagy can lead to many human diseases. Atg8 in yeast (LC3 in humans) is a key protein during autophagy and when fluorescently tagged, GFP-Atg8 can be monitored both visually and biochemically as qualitative and quantitative tool. Successful delivery of GFP-Atg8 to the vacuole results in release of free-GFP. When GFP-Atg8 is paired with candidate gene knockouts, we can use this assay to identify unknown pathway players. The goal of my project was to develop a protocol for this assay. To do this we compared GFP-Atg8 in wild-type cells and a variety of autophagy mutants. We found that our protocol successfully monitored autophagy in the wild-type yeast cells and mutant cells. Therefore, we believe our protocol can be useful in identifying specific genes that contribute to autophagy which can lead to more insight on various human diseases.

Title: Diversity and Expression of Heat Shock Proteins in Cnidarians

Student Author: Taylor Maddux

Faculty Mentor(s): Dr. Adam Rietzel

College: Liberal Arts and Sciences

Heat Shock Proteins (HSPs) are a large group of diverse chaperone proteins present in all living organisms that are important for a spectrum of molecular pathways by interacting with 100s of other proteins. HSPs are separated into different families based on size, and there is extensive evidence showing how these chaperone proteins change expression depending on environmental stressors as well as type of cell or tissue. Cnidarians are a phylum composed of thousands of freshwater and marine organisms that are essential to the marine ecosystem function. HSP diversity and expression has been poorly characterized in cnidarians, which limits our ability to understand their potential functions in the health of these species, many of which are important for ecosystem functionality and health. In my research, I am identifying the diversity of the Hsp70 and Hsp90 families of proteins in cnidarian species throughout the phylum using BLAST searches in public databases. The sequences will serve to build a phylogenetic tree to build a larger understanding of the similarities of various HSPs in cnidarians in relation to other animals. Lastly, I will analyze the expression of dozens of HSP genes in particular cell types and development stages using previously published data to determine the shared and unique expression patterns across this family of proteins. Together, my research will uncover the evolutionary diversity of HSPs in an ancient group of animals and their unique expression patterns in a model cnidarian species.

Title: Deep Reinforcement Learning Debugger

Student Author: Shaishav Maisuria

Faculty Mentor(s): Dr. Minwoo Lee

College: Computing and Informatics

Deep Reinforcement Learning (DRL) has an enormous amount of useful applications based on their performance and ability to learn. However, for a long time, DRL has struggled with interpreting the complex system. A deep reinforcement learning agent requires interacting with an environment, collecting experience (data), analyzing the experience, and learning an optimal policy to maximize the expected rewards, which involves complex processes that are extremely challenging and tedious to debug. Therefore, there is a need for an effective debugging tool that helps users to easily debug all the DRL processes. Thus, this study focuses on preparing a prototype debugger that uses Deep Reinforcement Learning Monitor (DRL-monitor) and statistical tools to inspect, analyze, and interpret complex information in a more user-friendly and understandable format. DRL-monitor memorizes important moments from agents' experience obtained during the training process and uses Bayesian inference that provides useful information to convert the complex information into a more understandable format (Dao et al., 2018). Moreover, the debugger will help to record the statically obtained information and interpretation. This information from the debugger will then be displayed in our GUI. Hence, the final product will provide the ability to debug, record, analyze, and interpret the agent experience at any stage of training state-of-the-art DRL algorithms. The CRS project strives to build a simplified user interface that helps to record and find errors in the DRL agents' training. Therefore, we expect that our GUI will allow the user to concentrate on guiding the model for developing more reliable ways to train an agent.

Title: An Investigation of Teachers' Perceptions of Advanced and Non-advanced Primary Grades Students' Mathematical Self-efficacy

Student Author: Hayley McNeill

Faculty Mentor(s): Dr. Drew Polly

College: Education

The purpose of this paper is to examine the perceptions of primary grades (Grades K-2) teachers of their students' self-efficacy in mathematics in order to examine differences between advanced students and their classmates. Further, this study examined teachers' report of instructional methods and strategies used to meet the needs of their students. Self-efficacy is known to affect academic performance; therefore, this study looked to confirm this theory and understand how self-efficacy differs in advanced and non-advanced students in K-2 classrooms from a teacher perspective. The term advanced in this study is used in replacement of the term gifted as these students are not formally identified until Grade 3. Twenty-four teachers filled out an electronic survey with 10 open-ended questions. On the survey, participants were given information to assist them in the classification of advanced students present in their classrooms to ensure equitability. Data from responses was analyzed through a constant comparative process in order to find the answers to the research questions. Teachers indicated that advanced students generally have a higher mathematical self-efficacy than non-advanced students, therefore having a greater potential to academically achieve at a higher level. Additionally, many of the respondents did not differentiate the methods and strategies used between advanced and non-advanced students. Future research should include specific mathematical strategies that are beneficial to both groups of students besides differentiation in general. Advanced students are often marginalized in the classroom and their abilities need to be nurtured in order to sustain them. Future research should also include teachers' perceptions of the overall mathematical self-efficacy in mixed ability K-2 classrooms to further add to the literature.

Title: The Expression, Function, and Evolution of Major Intrinsic Proteins in the Phylum Cnidaria

Student Author: Olivia Mikula

Faculty Mentor(s): Dr. Adam Reitzel

College: Liberal Arts and Sciences

Aquaporins and aquaglyceroporins are Major Intrinsic Proteins (MIPs) that serve as transportation channels that allow water and other small molecules to travel across the cell membrane using electrostatic repulsion and amino acid selective filters. This function is necessary for all organisms. Therefore, MIPs are an ancient family of proteins that evolved to be highly diverse making them a valuable source of evolutionary insight. Eight genes that code for these proteins have been previously identified within the model cnidarian, *Nematostella vectensis*. Cnidarians are a phylum of animals that are important for ecosystems (example, coral reefs) and are informative for the evolution of gene families and protein function due to their phylogenetic position as an outgroup to vertebrates and insects. Currently, there are no reported data on the expression or potential function in membrane selectivity of these specific *Nematostella* proteins. Furthermore, there has not been a systematic analysis of the evolution of MIPs in cnidarians. My research is aimed to identify the diversity and evolutionary relationships of MIPs in cnidarians by searching within databases to collect similar proteins present in other related species. These protein sequences were then used to create a phylogeny 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 various developmental stages and within 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 which offers information on the evolution of the particular function.



Title: Do Restored and Natural Salt Marshes Exhibit Similar Nekton Biodiversity?

Student Author: Megan Mitchem

Faculty Mentor(s): Dr. Paola López-Duarte

College: Liberal Arts and Sciences

Salt Marshes provide both ecological and economic advantages for coastal communities. These environments serve as refuge for many fish and invertebrate species, help protect the shoreline from erosion, and prevent flooding. In the last century, over 4,800 km<sup>2</sup> of the Louisiana coastline has been eroded. If restorative measures are not taken, there is a projected loss of an additional 4,500 km<sup>2</sup> within the next 50 years. In 2012, two depreciated marsh habitats within the West Point a la Hache area of Barataria Bay in Plaquemines Parish, Louisiana were restored. Our research objective is to compare the levels of biodiversity of restored (newly-created) marshes relative to nearby natural marshes. In 2018 and 2019, nekton samples were collected at the two restored marshes and from four natural marshes. The samples were collected using wire-mesh traps deployed at the creeks, ponds, and edges of each site. Biodiversity at each site and sub-habitat was calculated using the Shannon Diversity index ( $H'$ ). When we examine biodiversity based on year of collection, preliminary results suggest biodiversity indices during the second sampling year are more consistent across sites than in the first year. This is further confirmed by the results of two-factor ANOVA tests for each year. In 2018, there was a significant difference in biodiversity among sub-habitats ( $p= 0.034$ ), no difference among sites ( $p=0.533$ ), and a significant interaction among sites and sub-habitats ( $p=0.007$ ). In 2019, there was a significant interaction between sites and sub-habitats ( $p<0.001$ ), but no main site ( $p= 0.556$ ) or sub-habitat ( $p=0.673$ ) effects. These results suggest that overall, restored and natural marshes have similar biodiversity indices, but the differences across sub-habitats are site-specific. This information is relevant to the creation of new marshes because the species each sub-habitat supports have different ecological and economic values and future restoration projects should maximize production and profit.

Title: Race, Gender and Coverage of the 2020 Democratic Presidential Primary

Student Author: Chloe Nicola

Faculty Mentor(s): Dr. Mary L. Atkinson

College: Liberal Arts and Sciences

Although women and minority participation and acceptance in politics has drastically improved since Victoria Woodhull ran for president in 1872, race and gender stereotypes still present challenges for people of color and women who seek elective office-especially at the highest levels. Some of the most harmful obstacles to a woman's campaign can derive from the media's coverage of gender stereotypes, gendered traits, and gendered political issues. For example, women often face doubts in their ability to handle international affairs or military matters because women are categorized as nurturing and honest, while men can better fill the role as tough negotiators and decisive leaders. These labels make it difficult for women to seek the presidency even though female candidates have been increasingly successful at the local level. This research seeks to apply these currently understood challenges of female and minority candidacies to the 2020 democratic primary election to determine how and to what extent biased media coverage affected the campaigns of the many female and minority candidates. To pursue this research question, news articles from the New York Times and USA Today were compiled and coded for mentions of credentials, policy positions, race, sex, sexual orientation, and age. After the coding is completed, we will use a difference of means test to analyze if there is a disparity in the coverage received by female and minority candidates. We expect the article coding will reveal that female and minority candidates still face media bias in the coverage they receive. Specifically, we expect women's policy positions to receive less attention and for women and candidates of color to be considered less viable by the news media than their white, male peers.

Title: Literature Review and Study of Hexacoordinate Silicon Complexes used within Organic Light Emitting Diodes

Student Author: Katherine Norman

Faculty Mentor(s): Dr. Thomas Schmedake

College: Liberal Arts and Sciences

Organic electronic devices, such as organic light emitting diodes (OLED) and solar cells, use a combination of organic materials to interconvert light and electricity and to transport charges through the device. The challenge of transporting electrons in or out of the device is achieved by the electron transport material (ETM) or layer (ETL). The need for more energy efficient and renewable material for ETL has become a prevalent issue within the flexible electronics industry. Hexacoordinate silicon complexes, which hold a central, neutral silicon attached with six bonds to two ligands, demonstrate an alternative to traditional compounds, such as tris(8-hydroxyquinolino)aluminum (Alq<sub>3</sub>). This alternative shows improved quality when deposited as films in devices, as well as being more stable in water and other qualities. Three different hexacoordinate silicon complexes, starting with ligands, and their corresponding analogs, were analyzed and information was compiled to compare their strengths and weaknesses within different aspects of fluorescence and potential application within electronics. The first complex includes 2,6-bis(benzimidazol-2'-yl)pyridine (bzimpy) ligand, the Si(bzimpy)<sub>2</sub> complex and the analogs: Si(MeO-bzimpy)<sub>2</sub>, Si(Me<sub>4</sub>bzimpy)<sub>2</sub>, and Si(MeOMe<sub>4</sub>bzimpy)<sub>2</sub>. The second complex includes 2,6-bis(2'-indolyl)pyridine (BIP) ligand, and the Si(BIP)<sub>2</sub> complex. The third complex includes 2,6-bis(imidazolyl)pyridine (IPI) ligand, and the Si(IPI)<sub>2</sub> complex. The goals of this research were to 1) study the three previously synthesized hexacoordinate silicon complexes, ligands, and their corresponding analogs through scholarly articles, 2) analyze and compare their fluorescent properties, and 3) hypothesize how these complexes may be used within the future of organic electronics. Properties including electron mobility, optical properties such as fluorescence and ultraviolet-visible spectroscopy, x-ray crystallography, and cyclic voltammetry were analyzed using primary literature sources.

Title: Mechanical Tuning of the Terahertz Photonic Bandgap of One-Dimensional Photonic Crystals Fabricated by Stereolithography

Student Author: Brandon Norton

Faculty Mentor(s): Dr. Tino Hofmann

College: Liberal Arts and Sciences

Recent advances in additive manufacturing techniques enabled the fabrication of optical components such as lenses, filters, waveguides, and diffractive optics for the THz spectral range. We use stereolithography, an additive manufacturing technique, for the fabrication of THz-optical, one-dimensional photonic crystals here. One of the most striking properties of photonic crystals are spectral regions of high-reflectivity in the electromagnetic spectrum often referred to as photonic bandgaps. We demonstrate for the first time that the terahertz photonic bandgaps of one-dimensional photonic crystals can be shifted using compressive strain. The photonic crystals studied here were fabricated in a single stereolithographic fabrication step and are composed of alternating high and low-density polymethacrylate layers. The photonic bandgap of the crystals is located in the W-band which covers frequencies ranging from 105 to 115 GHz. While the low-density layers are compressible and consist of sub-wavelength-sized columnar structures, the high-density layers are in-compressible with no intentional internal structure. In order to facilitate reversible compression, the columnar structures in the low-density layer are oriented at  $45^\circ$  relative to the layer interface. Optical transmission measurements were obtained in the spectral range between 82 and 125 GHz for different compressive strains on the photonic crystal. The collected transmission data was then analyzed using stratified layer model calculations. We found that the bandgap center frequency was able to be shifted by 11.6 GHz using compressive strain. The stratified layer model calculations are in good agreement with the experimental data and the best-model parameters correspond to the nominal geometric values of the photonic crystal within their confidence intervals. In conclusion, we envision one-dimensional photonic crystals fabricated using stereolithography as a useful THz optical component when easily tunable reflective and transmissive properties are required.

Title: Grief, Anger, and Solidarity: Examining the Role of Twitter in Emotional Responses to the Mass Shooting at the University of North Carolina.

Student Author: Sarai Ordonez

Faculty Mentor(s): Dr. Jessamyn Bowling

College: Health and Human Services

Mass shootings have become more prevalent, with the amount of mass shootings increasing by 2.4 times in the past decade. School shooting prevalence is also increasing. In April 2019, a deadly shooting occurred at the University of North Carolina Charlotte where two students died and four more were injured. Shootings and deaths leave emotional damage on communities that can often be overlooked and unaddressed. This study used Twitter due to its ability to analyze emotional reactions in unfiltered and organic ways. Though past studies on social media gun violence have looked at risk factors and emotional responses to loss, there is no uniform approach to analyze Twitter data. Previous studies have used natural language processing programs to analyze emotions in social media posts, which can misinterpret emotions. This study seeks to analyze emotional responses via Twitter to the April 30th UNCC shooting using trained coders. Researchers used qualitative methods to analyze tweets. Relevant tweets between 4/30/2019-5/7/2019 were pooled using keywords like "shooting", "UNCC" and "NinerStrong". A random sample of 75,000 tweets were extracted from the initial 2.5 million tweets. Tweets irrelevant to the UNCC shooting or national gun policies were excluded. An initial codebook was created based on preliminary data reviews and existing Twitter literature. Each tweet was coded for emotional content. Emotions were then mapped with the time sequence to examine changes over time. Preliminary analyses include negative emotions, uncertainty, and regret. More positive emotions such as gratitude are expected to appear later in the week following the event. By examining the role social media plays in emotional responses to mass shootings and identifying time trends, campus approaches and interventions may be tailored to address mental health and emotional needs. This can aid addressing gaps in information dissemination following gun violence events.

Title: Culturally Diverse Classroom Libraries and Their Effect on Culturally Inclusive Teaching

Student Author: Olymbia Palamaris

Faculty Mentor(s): Dr. Erin Miller

College: Education

This paper focuses on culturally diverse literature in the elementary school setting and its effect on culturally inclusive teaching practices. The focal points of the study are centered around a) incorporating culturally inclusive literature into the Common Core Standards, b) the effect culturally inclusive teaching practices have on families and diverse student populations, c, ) supporting educators and librarians in using culturally inclusive literature, and d) how digital media can affect culturally responsive teaching practices. A current limitation in the research conducted prior to this study is the underutilized Low Classroom Library Questionnaire. Additionally, another limitation encountered was the lack of an elementary school that has culturally inclusive teaching practices incorporated into the curriculum with the Common Core State Standards. Primarily, the purpose of this study is to shed light on the benefits of incorporating culturally diverse literature into the curriculum to make instruction more culturally inclusive. The study itself is mixed methods. The qualitative research will be conducted via survey sent to teachers at an elementary school in the Kannapolis City Schools District to collect information from educators on culturally responsive teaching practices. The responses from the surveys will be cross analyzed for similarities and differences in teaching practices, as well as the thoughts accompanying this topic. Additionally, the quantitative research will be conducted using the Lee and Low Classroom Library Questionnaire on the main online databases educators purchase their books from. The findings of this study will determine whether or not there is culturally inclusive literature in elementary school settings and its effectiveness.

Title: Poverty Suburbanization and the Changing Job Accessibility Landscape

Student Author: Claire Patrick

Faculty Mentor(s): Dr. J. Claire Schuch

College: Liberal Arts and Sciences

Job decentralization and 'White flight' into the suburbs during the mid 20th century created a concentration of low income and Black residents in US center cities. However, since the 1990s, there has been a growing trend of urban reinvestment and a return of jobs and affluent residents moving back into the cities and a suburbanization of lower-income households. Well-researched patterns of poverty suburbanization suggest that low-income residents have a harder time accessing employment because of low density communities, fewer jobs and limited public transportation in metropolitan outskirts. However, little is known from the perspective of residents themselves who made this move in terms of the challenges, or opportunities, they encounter. This study included surveys and phone interviews with eight residents who had both moved beyond the Charlotte city limits to Charlotte MSA suburbs since 2010 and had a yearly income of below \$46,297 (HUD's definition of low income). Six participants earned less than \$28,936/year. Participants were recruited via neighborhood and community organizations and leaders in the Charlotte MSA, and 500 mailed flyers to low-income residents who had moved to the suburbs in the past year. Although their commute times had overall increased after relocating, most interview participants were happy with their choice to move out of Charlotte, mainly because of housing affordability. When asked what would provide better economic opportunities, interviewees were more likely to mention improved education or training than better transportation options, which suggests that employment difficulties were more related to a skills mismatch rather than spatial mismatch. Although the small, all-female sample makes it difficult to create any generalizing statements, interviewing low-income residents who have relocated out of the city and into the suburbs offers a personal perspective on the multi-faceted nature of their job accessibility.

Title: The Future Implications of Race Within Classrooms following Covid-19

Student Author: Alexis Porter

Faculty Mentor(s): Dr. Jason Giersch

College: Liberal Arts and Sciences

Covid-19 placed a huge burden on everyone as it hit the U.S. Most lost their jobs, forced to stay home to prevent spread and working from home became an official norm of 2020. One group who suffered a great deal involved students. Students faced hardships with minimal help on homework, review that started not long after online schooling became a must, and social lives became non-existent for students. During this pandemic, issues on race re-opened as violence from police placed many black people dead or seriously injured. Riots, protests, and pushes for groups like "Black Lives Matter" crowded social news. This incident is not the first, and largely not the last, of events that surround the conflicts of race and equality. The focus area involves middle-grade social studies teachers, as their curriculum focuses on both state and federal events. However, to find out the necessary background information, reviewing both online articles on race in classrooms and teacher survey can place insight on how teachers follow this one topic. Online articles on race give a basic background along with scientific findings. Additionally, the articles set the stage for previous changes and potential future changes. Surveys on teachers allow insight on how this control can be combated or further enforced. Both sets of collecting information impact student's mindsets. With the occurring events, details of certain periods in time like slavery or the Civil Rights Movement can change. Following this idea, looking into the past can better determine why things occur one way and what will change in the future of education.



Title: Substance Use and Suicide in Individuals Recently Released from Jail or Prison

Student Author: Phoebe Pruneda

Faculty Mentor(s): Dr. Annelise Mennicke

College: Health and Human Services

**Introduction:** In the United States, 7 million people are released from jail, and 600,000 people are released from prison each year (Dumont et al, 2012). This project sought to examine existing literature addressing reintegration that answered the question: How does drugs and alcohol use contribute to suicide completion for individuals recently released from prison or jail?

**Methods:** We used keywords such as: "substance ab/use", "drug-related", "suicide decedent", "intentional overdose", "suicide fatality", "ex-offender", "post-release", and "post-incarceration" in databases such as: PubMed, ProQuest, SpringerLink, PsycINFO, SAGE, Taylor & Francis Online, and Wiley Online. Over 40 articles were identified that related to the topic of suicide and substance use, substance use and post-release, post-release and suicide, and post-release.

**Results:** People recently released from incarceration are four times more likely to die by suicide compared to their non-incarcerated peers (Lize et al, 2015), and are most vulnerable within the first 28 days after release (Haglund et al, 2014). These individuals have higher rates of substance use after release and substance-related deaths (Chang et al, 2015). Toxicology reports on public suicides suggest that nearly half of all tested decedents used substance prior to death (Galway et al, 2016). Substance use and suicide are connected, but researchers are unsure of whether or not substance use directly affects suicide behaviors, or if it aggravates factors that cause suicide (Gossop, 2005). Only one study directly answered our research question, finding that the most common factors for suicide fatalities among post-release populations were substance use, a history of substance dependency, and previous suicide attempts (Haglund et al, 2014).

**Discussion:** Preliminary research suggest that alcohol and drug use may directly impact suicide in individuals who are recently released from prison or jail. Further research is needed to examine this relationship, and to identify ways to reduce suicide and substance use in returning citizens.

Title: Distance Constrained Clustering Without a Prior Knowledge of the Number of Clusters

Student Author: Prakruthi Reddy

Faculty Mentor(s): Dr. Srinivas Akella

College: Computing and Informatics

Clustering is the task of grouping together a set of data points based on their similarity. There are several applications of clustering in robotics; our research focuses on the line coverage problem, which is the coverage of linear environment features (e.g., road networks, power lines), by one or more robots, while respecting all the resource constraints (e.g., battery capacity, flight time) on each robot. The line coverage problem requires a clustering technique to partition a large graph (e.g., UNC Charlotte's campus road network) into small subgraphs by clustering the edges of the graph, to facilitate a solution that will satisfy the resource constraints on the robots. Initially, a k-medoid clustering approach was used to perform the clustering task. However, the limitation of k-medoids clustering to pre-specify the number of clusters, and the addition of distance constraints to the clustering problem, made for reasons to look for better clustering techniques. In this research, we plan to perform a literature survey of relevant existing research that looks at clustering problems with constraints, specifically those that would allow us to implement distance constraints between the cluster center and its farthest edge. To determine the number of clusters, we will look at clustering approaches that do not require a priori knowledge of the number of clusters, and instead identify it themselves, influenced by the similarity amongst the data points. Upon finding algorithms that most suitably satisfy our requirements, we will automate procuring datasets of real-world road networks from OpenStreetMap, so that we will have a substantial amount of data to analyze the efficacy and efficiency of our algorithms. In the last step of this research, we will integrate the clustering algorithm into the existing line coverage routine to test out the entire pipeline and apply metrics to analyze the results.

Title: Sex and Masculine Role Norms as a Predictor of Rape Myth Acceptance in Law Enforcement Officers

Student Author: Ricky Rodriguez-Cue

Faculty Mentor(s): Dr Jennifer Langhinrichsen-Rolling

College: Liberal Arts and Sciences

Rape myth acceptance (RMA) is often quantified by measuring perceptions of the blameworthiness associated with the actions of sexual assault perpetrators and survivors, estimates of falsely reported sexual assault cases, and scores on verified rape myth scales. Previous literature supports the notion that males endorse rape myths at higher rates than their female counterparts (Anderson et al., 1997). This sex difference has been replicated in studies measuring rape myth acceptance in law enforcement officers (Parratt & Pina, 2017). Female officers tend to score lower RMA scales and express more liberal views in regard to sexual assault victims (Brown & King, 1998). However, an analysis of prior research findings suggests that adherence to masculine norms could be another potential explanation for the RMA differences between male and female police officers. Thus, this study aims to increase understanding of the factors that are positively correlated with RMA in law enforcement officers, including the reliability of officer sex as a standalone predictor. Therefore, an online survey was administered to sworn officers employed by the Mobile, Alabama Police Department (n = 447, 412 males, and 35 females). To measure RMA, respondents were asked to estimate the rate of falsely reported sexual assault cases and complete the Illinois Rape Myth Acceptance Scale (IRMA). Masculine role norms were assessed with three stand-alone questions. It was hypothesized that greater adherence to masculine role norms would help explain the association between the sex of the officer and their endorsement of RMA. Analyses are ongoing. Conclusions, implications, and future directions will be discussed.

Title: Evaluation of Tornadoes in Hurricane Dorian

Student Author: Luke Rosamond

Faculty Mentor(s): Dr. Casey Davenport

College: Liberal Arts and Sciences

On September 5, 2019, Hurricane Dorian spawned almost two dozen tornadoes as its rainbands impacted eastern North Carolina prior to landfall. While many of these were weak tornadoes (EF0 or EF1), there were also two strong tornadoes that caused significant (EF2) damage in Carolina Shores and on Emerald Isle. Hurricane forecasting has improved significantly in recent decades, yet there are still challenges when predicting the details of smaller-scale phenomena within hurricanes. Among these, it is particularly important to understand the tornadoes that form in the rainbands of a landfalling tropical cyclone since it remains difficult to forecast the significance and location of the threat. Toward this end, the goal of this project was to analyze the environments of the cells that spawned these tornadoes. Using storm reports from the Storm Prediction Center, the cells associated with tornadoes were tracked throughout their lifetime using NEXRAD radar data. From there, latitude and longitude points representative of the inflow environment of the embedded supercell were collected for the nearest hour before, during, and after the formation of the tornado it spawned. If a cell spawned multiple tornadoes, the same points were used for the overlapping hours. Next, vertical profiles of temperature, moisture, and wind were retrieved from the Rapid Refresh model at each of these points; only data not contaminated by nearby storms was retained. From there, the evolution in thermodynamic and kinematic parameters based on this environmental information was analyzed, with a focus on determining factors that could be used to predict tornadogenesis. Additionally, correlations between tornado intensity and the nearby environment were also examined to further enhance predictability.

Title: Task Goals Affect Interpersonal Communication

Student Author: Sydney Roux

Faculty Mentor(s): Dr. Alexia Galati

College: Liberal Arts and Sciences

The benefits of interpersonal alignment on task performance are documented in tasks that require partners to closely monitor each other's perspective, consistent with a prominent view that as task partners align their behavior they converge conceptually. However, it is still unknown whether or not these benefits can be generalized to other tasks. For example, in a joint visual search, performance could benefit from a "divide and conquer" strategy. We examine this question directly by manipulating task goals as dyads interact with maps. Sixteen dyads complete ten trials. Five trials involved planning a route from an origin to a destination (route planning) and five involved searching for landmarks (visual search). For our project, we focused on a map of London train routes. Eight dyads completed the route planning task and eight completed the visual search task. Interactions were transcribed and coded for train line colors and spatial expressions. We predict that there will be more instances of using train color lines during the route planning task to help the pair understand the map's layout and helps to reach a consensus at the end of the task. Moreover, we predict fewer instances of train line colors during the visual search task due to the nonlinear nature of the task. In other words, it would be more effective to use spatial expressions to point out the name of a specific station. Our findings can show how certain language use compliments and facilitates different interpersonal communication depending on the task goal.

Title: An Examination on How a High Desire for Control can Impact Suicidal Ideation

Student Author: Neielle Saint-Cyr

Faculty Mentor(s): Dr. Robert J. Cramer

College: Health and Human Services

Suicide is a preventable global epidemic. Having a high Desire for Control (DoC) is a characteristic trait that has not been looked at frequently as a factor that may influence suicidal ideation. The objective of this study is to examine how a high DoC can impact suicidal ideation. This study tests a high DoC as a threat-to-self and a motivational moderator in the Integrated Motivational-Volitional (IMV) Model of Suicidal Behavior, a model that suggests that suicidal behavior results from an interplay of factors. The IMV model of suicidal behavior seeks to extend the understanding of why people die by suicide with a specific focus on the psychology of the suicidal mind. In the study, 116 adults living in the United Kingdom and are currently working either part-time or full-time jobs, were asked to complete an online Qualtrics survey that investigates factors that may be associated with suicidal ideation and suicidal behavior. The online survey was advertised through poster displays and social media sites such as Facebook and Twitter. The sample was majority White, female, in their late twenties. Also, a majority of the participants identified as heterosexual. This study hypothesizes that having a high DoC can be a threat-to-self moderator that facilitates the transition from defeat to entrapment, and also a motivational moderator, that may facilitate the transition from feeling trapped to experiencing suicidal ideation and intent. In short, a high DoC increases the chances of suicidal ideation. Analyses are ongoing and will be presented in the final work product.

Title: Improving Health Care Outcomes for Infectious Diseases using Digital Technology

Student Author: Rachel Scott

Faculty Mentor(s): Dr. Monika Sawhney

College: Health and Human Services

Infectious diseases affect health and well-being at both the individual and population levels. Current research has shown that disease monitoring technologies can significantly improve health care outcomes and strengthen health systems for all stakeholders. However, focused research is needed to enhance a technology, especially concerning infectious diseases, that is both effective, reliable, replicable, and cost-efficient. Another important component that needs attention is compliance when extracting clinical information. After reviewing successful health care technology literature, ideas will come along for this project such as the use of notifications, screenings, and other health information. For this study, literature from multiple online databases (Pubmed, Web of Science, IEEE Xplore, ACM Digital Library) are being reviewed. The main concerns for this research are to incorporate/improvise aspects such as screening, diagnosis, and treatment adherence into a new digital system that will decrease the burden of infectious diseases and improve the efficiency of health systems. The focus of this study is to develop a system that incorporates different parts of the disease management system, enhances communication amongst all of the stakeholders, and overcomes the problems associated with current fragmented technologies. This study involves looking into different government compliance systems to enhance future digital systems that meet the need for regulatory compliance in the United States. Privacy and security have been identified as the primary concerns among users of available or existing digital technologies. Current literature has also expressed the need for more effective self-management techniques amongst users of these technologies. Results will allow for the development, testing, and implementation of a digital health system and reduce the burden of infectious diseases.

Title: Practice-Based Professional Development for Self-Regulated Strategy Development  
Within the Special Education Classroom

Student Author: Caitlin Shepherd

Faculty Mentor(s): Dr. Erin Fitzpatrick

College: Education

Self-regulated Strategy Development (SRSD) is an instructional approach that has proven to enhance student performance in writing. SRSD is a multi-component, criterion-based, flexible method that supports learners in acquiring skills, knowledge, and self-regulating practices necessary to be more effective writers. The SRSD framework includes direct instructional procedures that support students in addressing self-regulation throughout the writing process. One of the direct instructional strategies that supports students throughout the writing process is positive self-statements; specifically coping. Coping self-statements are taught to support students in dealing with the emotions of the workload, setbacks, and fatigue, a particular problem for students with academic and emotional challenges. SRSD research demonstrates by modeling positive coping strategies during the teaching process, teachers may help students persevere through the writing process and thus become better writers. Data for the current study are drawn from a prior study in which a special education teacher implemented SRSD for writing informational essays citing text-based evidence from two sources, following practice-based professional development (PBPD) with small groups of students. The teacher implemented the instruction with high fidelity and was in favor of PBPD and SRSD. Following intervention, student writing quality, evidence of strategy use, and number of words written increased as well as a decrease in the amount of plagiarism following this intervention. The purpose of the current study is to examine changes in the participating teacher's use of coping self-statements within her instruction, as she models the strategy to three different groups across the academic year. We seek to determine how the teacher's use of coping statements changed across multiple implementations of SRSD. Data sources are audio files and transcripts of the teacher's instruction during the explicit and collaborative models included in the SRSD framework. The research team will report descriptive statistics of the number and complexity of coping statements.



Title: Interpersonal Coordination Through Task Goals: Benefits Provided through Task Goal Metacomments

Student Author: Chelsea N Simcox

Faculty Mentor(s): Dr. Alexia Galati

College: Liberal Arts and Sciences

In joint tasks, success in accomplishing the goal at hand depends on the degree of interpersonal coordination. However, the impact of task goals on joint performance remains underexplored: individuals may converge or diverge as techniques of cooperation, depending on the task. For example, interpersonal alignment may be more beneficial to performance in joint tasks requiring perspective monitoring (e.g., route planning) than in more perceptual tasks (e.g., visual search). This question was examined directly by manipulating the task goals shared by dyads that interacted while using maps. Ten trials were completed by sixteen dyads, 5 consisted of searching for landmarks while the other 5 consisted of route planning. This project is based upon a single map of London where 8 of the dyads participated in a visual search task while the other 8 dyads participated in a route planning task. The interactions between individuals were both transcribed and coded for spatial expressions and metacomments that pertained to problem-solving strategies and progress on the task. We expect to find a difference in the usage of metacomments between tasks, with more metacomments used in the route planning task (which requires monitoring an imagined navigator's perspective) than the visual search task (which does not and may benefit from a "divide and conquer" strategy). This work can provide insights about the benefits of interpersonal alignment and complementarity across distinct types of tasks.

Title: Simulating Forces During Manual Manipulation of Ultra-Small Optical Fibers Within Flexible Ureteroscopes for Application in Thulium Fiber Laser Lithotripsy

Student Author: Austin A. South

Faculty Mentor(s): Dr. Nathaniel M. Fried

College: Engineering

Kidney stones are a common occurrence and affect 10% of the United States population. A common minimally invasive method for the treatment of kidney stones is ureteroscopic laser lithotripsy. This is an effective method which involves the insertion of a flexible ureteroscope through the urinary tract. However, due to current endoscope sizes, this procedure requires the use of a full anesthetic and creates a painful recovery process from ureter dilation. This size endoscope is necessary to account for the optical fiber as well as the multiple other tools used for extracting the stone. A miniature ureteroscope has the potential to save cost and time but requires the miniaturization of all inserted tools. Previous studies have shown feasibility in ablating kidney stones coupling a Thulium fiber laser (TFL) into a 50-micron fiber. This study discusses the mechanical limitations of threading various sized optical fibers down an ureteroscope. A Euler buckling analysis and Solidworks simulations were used to determine the maximum amount of force that could be applied on various sized optical fibers before they lost usefulness for insertion. These force values were compared to previous studies on the amount of force that is typically applied to a fiber in these conditions to determine which fiber sizes would be effective. Some fiber sizes were too large and risked piercing the ureteroscope while some were too small and were at risk of buckling during insertion. The ideal theoretical calculations differed from the simulation results by less than 0.2%. The results will show the range of fiber sizes that are optimal for use during lithotripsy.

Title: Effects of Dimer Interface Mutants on Heat Shock Response

Student Author: Jade Takakuwa

Faculty Mentor(s): Dr. Andrew Truman

College: Liberal Arts and Sciences

Heat Shock Protein 70 (Hsp70) is an evolutionarily well-conserved molecular chaperone that is critical in all organisms. Hsp70 is involved in several cellular processes such as folding of proteins, modulating protein-protein interactions and transport of proteins across membranes. While most of the major chaperone and co-chaperone proteins (such as Hsp90, Hsp40, Hsp104, P23) have been shown to exist as dimers and require dimer formation for basic function, Hsp70 has always been assumed to exist as a monomer. Recent cross-linking mass spectrometry studies from our lab have shown that yeast Hsp70 (Ssa1) forms a homodimer, but the conditions under which the dimer is formed remains unknown. Further research into the function of dimerization in heat shock response could reveal important insights into the interaction of Hsp70 with its co-chaperones and its effect on other transcriptional factors. This study aims to determine the biological role of Hsp70 dimerization and understand the regulation of dimer formation in cells. To better understand the role of dimerization, we introduced mutations that are known to interfere with the dimer interface of Ssa1. We tested various stressors such as UV exposure, caffeine, heat shock and DNA damaging agents such as hydroxyurea and found that the dimer interface mutants exhibited phenotypical effect under high temperature. In order to accurately follow the transcriptional pathway of the heat shock response, we utilized a destabilized reporter system and found that the dimer interface mutant was defective under heat shock. Going forward we will determine the mechanisms behind temperature-dependent dimerization of Hsp70 by microscopy and further proteomics studies.

Title: Multilingual Marshallese Children and Their Language use in the South-Central United States

Student Author: Dmitry Tereshenko

Faculty Mentor(s): Dr. Elise Berman

College: Liberal Arts and Sciences

This project is the first analysis of multilingual Marshallese children's language use in the south-central United States. All observations and conclusions presented are drawn from two photo-elicitation interviews that take place with questions in both English and Marshallese. Preliminary analysis suggests the children fluently translanguage between multiple varieties of Marshallese and English, including a largely undescribed non-dominant variety. We identify two primary systematic uses of non-dominant English syntax: (1) s-neutralization in third person singular and possession forms and (2) tense/aspect neutralization. There are also observed uses of distinct lexical variations to express the notion of taking a picture/video that differs from dominant forms expected in schools. These preliminary findings challenge existing biases and ideologies regarding Marshallese children in the school system and suggest a critique of theory regarding language use in bilingual environments. First, although Marshallese children are overwhelmingly marked as English Learners in the school system, these children seem to be more comfortable using resources perceived as English. They do regularly use non-dominant, and largely unrecognized forms, suggesting that ideologies and assessments of Marshallese children's language as "different" or as "non-English" may be systematically biased and discriminatory. Second, theoretically, our preliminary findings raise questions about current ideas of "translanguaging" as the best description of children's multilingual language practice. Currently, although there is individual variation, the observed patterns seem to appear across both children and, potentially, even English as used in the USA and the Republic of the Marshall Islands. These findings question ideas of "ideolects" that are central to translanguaging theory.

Title: Mechanisms of Polymerase Eta in Genome Integrity and Cancer Biology

Student Author: Amit Thota

Faculty Mentor(s): Dr. Shan Yan

College: Liberal Arts and Sciences

Cells in our body are constantly exposed to various endogenous and exogenous genotoxic insults, such as UV radiation, ionizing radiation, and 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 unreparable, 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 a group of specialized DNA polymerases named Translesion Synthesis (TLS) polymerase which bypass DNA lesions until the replicative DNA polymerase takes over. Pol Eta, a TLS polymerase, is known to have a role in Nucleotide Excision Repair (NER), a type of DNA repair pathway. A mutation in pol eta is also known to have high risk of skin cancer in Xeroderma Pigmentosum (XP) patients. Cancer cells are showing sensitivity to Pol eta along with other protein inhibitors and promoters pointing to a potential way to cure certain types of cancer. In this review, we focus on uncovering the connections between DDR and DDT pathways. We provide updated understanding of the various DDR pathway, DNA repair pathways, and DDT pathways. In particular, we will dissect and summarize distinct function and mechanisms of Pol eta in DNA repair, DDR, and DDT pathways in oxidative stress. We also examine the function of Pol eta in cancer biology. 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.

Title: Identity and Jewish Women Writers in 19th Century England

Student Author: Molly Unrath

Faculty Mentor(s): Dr. Alan Rauch

College: Liberal Arts and Sciences

Although often overlooked, Jewish women writers in the nineteenth century provide insight into the complexity of Anglo-Judaic identity and ideology. Jewish women authors, specifically Grace Aguilar, Anna Maria Goldsmid, Amy Levy, and Nina Salaman, reveal their identities through their literature and engagement with their community and Britain's intellectual readership. While feminist ideology was growing in strength and prominence, rights and opportunities for women were limited. At the same time, full Jewish emancipation did not occur until the mid-nineteenth century in England, further complicating the authorial identities of Jewish women. This project aims to capture the range of concerns and constraints faced by these women. The works of Aguilar—such as *Home Influence: A Tale for Mothers and Daughters* and *Woman's Friendship*—explored ideas of domestic feminism and the importance of a mother's role in education. Salaman's devotion to education and maternal instruction inspired much of her writing as did her political commitment to Zionism. Goldsmid was a passionate reformer both within the Jewish community and as a citizen of Britain at large. These writers represented themselves positively as Jewish women as well as reformers and writers of significance despite the challenges along their paths. Levy's renowned novel *Reuben Sachs* was an effort to mitigate both public and self-perceptions of Jewishness to depict the anxiety of reconciling identity with the demand of the nineteenth century. Each of these women had diverse experiences and negotiated cultural and social constraints differently, yet it is crucial to understand how the intersecting and challenging identities of these authors, as Jewish women, helped shape England's social and literary culture.

Title: The Complex Post-translational Modifications of Heat Shock Factor: An Integrated Signaling Platform for Cell Stress

Student Author: Megan Ward

Faculty Mentor(s): Dr. Andrew Truman

College: Liberal Arts and Sciences

Cells have evolved a cellular program to deal with misfolded proteins, the heat shock response (HSR) which is controlled through activation of an essential transcription factor, Heat shock factor (HSF). During proteotoxic stress conditions, HSF trimerises, binds to DNA and induces the expression of the molecular “chaperone” heat shock protein (Hsp). These chaperones function as cellular repair proteins that are able to bind and refold damaged client proteins which otherwise could aggregate within the cell, a condition which is associated with diseases such as Huntington’s and various cancers. Once the damage has been repaired, HSF becomes monomeric and inactive, resetting the system. HSF undergoes several post-translational modifications (PTMs) such as phosphorylation, acetylation, ubiquitination, and SUMOylation. Some modifications, such as phosphorylation, act to alter the transactivation capacity of HSF1 through the reduction or enhancement of transcription rates. Others, like acetylation, regulate the ability of HSF1 to bind to the heat shock element and express genes. PTMs are often the result of cellular stress such as heat or exposure to heavy metals, but many others aid in the regulation of cellular processes such as maintaining homeostasis. It is known that HSF1 is very heavily modified following translation. However, the many effects of these post-translational modifications are a newly emerging area of study and are therefore not well-characterized. Recent data suggests that HSF can become mutated in cancer and that HSF may play a role in cancer cell growth and metastasis. In this review, we surmise the roles and regulations of known HSF PTMs, discuss potential roles for those that are uncharacterized and analyze overlaps between HSF PTMs and mutations that occur on HSF in cancer.

Title: How Characteristics of Association Executives Correspond to Board Diversity

Student Author: Jake Weist

Faculty Mentor(s): Dr. Jaclyn Piatak

College: Liberal Arts and Sciences

Board diversity tends to be a prominent goal of associations and nonprofit organizations. A more diverse board can improve operations, foster inclusion among board members, and illustrate a commitment to social justice, among other positive effects. Having a diverse board is of paramount importance to an association's success in the modern world. Associations are a group of people organized for a common purpose, but are their boards representative of those served? While research has examined the need for benefits of board diversity, we know little about how executive characteristics shape board diversity. The need for more diverse leaders continues to be a challenge for associations and many other organizations. This study builds upon prior research by focusing on how a more diverse board can be achieved by looking at the role the association executive plays in the board diversity of their association. Using a database of the largest trade associations and professional societies in the US based on operating budgets, this study examines how the gender, education, tenure, and prior public service experience of executives may influence the diversity of their association boards. Specifically, we will examine whether women have more diverse boards, whether a more educated executive has a more diverse board, whether more experienced executives have more diverse boards, and whether executives with prior work experience with nonprofits or government organizations have more diverse boards. Without having done any statistical analysis yet, our hypotheses would be that women executives would have more diverse boards, as well as executives with more experience, higher levels of education, and prior government or nonprofit work experience.



Title: Mobility Strategy for the Future of NC Piedmont Cities

Student Author: Connor Welch

Faculty Mentor(s): Dr. William (Bill) Graves

College: Liberal Arts and Sciences

North Carolina's initial industry, textiles, utilized remote locations to keep labor costs low. As a result of this, the population of North Carolina has continued to be scattered and low density after becoming one of the most industrialized states in the nation. Consequently, the current urban system lacks many opportunities for a 21st-century knowledge economy to flourish. This project focuses on integrating North Carolina's fragmented high-skill labor market in a way that increases the visibility of NC cities to global workers and firms. To achieve this, the focus will be modifying and improving the current infrastructure to make railways more attractive to commuters. Additionally, the sprawl of this urban system is unsustainable in terms of carbon emissions produced by daily circulation. To assist in the reduction of carbon emissions a carbon pricing system will be considered. Determining the economic impact that a carbon pricing system would have in addition to a transition to rail transport, a carbon pricing calculator was created. The calculator takes commuting data, travel distance, average carbon output per mile, and a carbon price per metric ton to determine the total cost of carbon per one-way trip. Growth rates as well as the growth of carbon costs can be accounted for to determine the future cost reductions vs. construction costs of the improved railway system. The primary objective is to create a cost-benefit analysis of commuters shifting from automobile to rail for portions of the primary commute system from Raleigh to Charlotte while also reducing fragmented high-skill labor and carbon emissions.

Title: Novel Combinations of FDA Approved Drugs and Oncolytic Vesicular Stomatitis Virus for Treatment of Pancreatic Cancer

Student Author: Isha Wilson

Faculty Mentor(s): Dr. Valery Grdzlishvili

College: Liberal Arts and Sciences

Oncolytic virotherapy is a relatively novel anticancer approach that utilizes replication competent viruses to specifically infect and kill tumor cells. Vesicular stomatitis virus (VSV) is one such oncolytic virus (OV) and is already in several phase I clinical trials against different malignancies. Our recent studies demonstrated that VSV is effective against the majority of tested human pancreatic cancer cell lines, both in vitro and in vivo. However, we found that some pancreatic cancer cell lines are resistant to VSV infection, replication, and virus-mediated oncolysis. In this study, we investigated whether we could identify the Food and Drug Administration (FDA) approved pharmaceutical drugs that could sensitize cancer cells to VSV. The FDA Approved Drug Library has not before been screened in its entirety to evaluate how the broad variety of drugs may increase viral replication of an oncolytic virus. Also, in general, it is important for clinicians to know different FDA-approved drugs affect VSV if used during oncolytic virotherapy. We hypothesized that by screening the entire library, which contains 1971 FDA-approved drugs, we will be able to identify drugs dramatically enhancing replication of VSV in cancer cells. The Drug Library is organized into 17 different 96-well formatted plates. The five cell lines used were seeded into 96-well plates as well and infected in columns 1-11 with controls of virus alone, virus and a control drug, and no virus or drug added into wells in column 12. After an hour of infection, the virus was aspirated and the drugs from the library were added. VSV- $\Delta$ M51-(GFP) expresses the green fluorescent protein and the level of viral replication was detected using a fluorometer. The measurements were taken starting at 1-hour post-infection (h p.i.) of VSV and the addition of the drugs from one of the 17 diluted copy plates. The remaining time points were taken at 24, 48, 72, and 96 h p.i. Two independent screenings identified several drugs stimulating VSV- $\Delta$ M51-GFP replication in varying amounts in different capacities across the range of cell lines used. Interestingly, several commonly used pancreatic cancer chemotherapeutics were seemingly ineffective or even inhibiting VSV replication in all five cell lines. Our study is critical to the development of rational chemovirotherapy approaches to enhance oncolytic virotherapy efficacy and broaden the spectrum of pancreatic cancers that can be successfully treated.

Title: Biomedical Applications of Polyhedral Oligomeric Silsesquioxanes: A Review

Student Author: Zaneta Zhin

Faculty Mentor(s): Dr. Juan Vivero-Escoto

College: Liberal Arts and Sciences

Polyhedral Oligomeric Silsesquioxane (POSS) is not only known for its unique nanoparticle silica commonly applied in nanotechnology but also popularly used in biomedical treatments, specifically for drug and gene carriers, and, most importantly, anti-cancer therapy. It is an ideal building block as its main base synthesizes with several reactive organic functional groups to construct a three-dimensional structure. POSS is an organic-inorganic nanocomposite, particularly an efficient carrier in various biocompatible applications in vitro cellular composites. It is highly favorable in low cytotoxicity, phototoxicity, stability, thermal, efficient cellular uptake, and nanoscale size. Depending on the structure and reactivity of any vertex groups, POSS continues to be introduced into practically any existing polymer systems. Based on past research, researchers focused on different organic compounds synthesized with POSS widely examined by using high-performance materials, such as bioimaging, biosensing, and drug therapy: photodynamic therapy (PDT) and photodynamic inactivation (PDI). It has also reflected on enhancing efficiency and examining the outcome of which carriers collectively produce a higher probability of drug molecules trapped inside the cellular structure. By using these high-performance materials, researchers have taken into consideration that selected mechanisms performed to construct stable caged-POSS is a time-consuming, multi-step process to produce a good percentage yield based on previous, published journals. Overall, POSS can have the potential for targeted cancer cells. These works, itself, describe the development of the preparation and properties of POSS-containing polymers. Furthermore, it gives an overview of a wide range of applications for POSS-based composite systems, including drug and gene delivery systems.

# Co-OPS Program

Title: Developing the Community Oversight of Privacy and Security Mobile App

Student Author: Nicholas Osaka and Brandon Poletti

Faculty Mentor(s): Dr. Heather Lipford

College: Computing and Informatics

Privacy and security concerns are increasingly a point of discussion among modern communities. People rely on their friends, family and other loved ones to help make informed decisions about their digital privacy and security. However, these social processes are rarely supported by technology. This project proposes a community oversight model that identifies mechanisms for members of a community to help others with making security and privacy decisions. We are evaluating this model with mobile app permission decisions through the design and deployment of a community oversight of privacy and security (CO-oPS) mobile app. The CO-oPS mobile application is designed to provide meaningful, contextual, and functional discussions surrounding privacy and security concerns between members of a community. The app analyses metadata of the applications installed on the users' mobile phones, then shares this information with the user's community alongside discussion and comments regarding privacy and security. A user study will be conducted using this app in order to collect information on how interactions between members of the community evolve over time. Metrics that can provide evidence of an effective community oversight model include: revocation of permissions from applications performing unnecessary data collection, interaction with community "tech caregivers" that result in meaningful conversations about security and privacy, and frequent utilization of the community social feed feature. During this summer research project, we implemented the CO-oPS mobile application. Features introduced in the CO-oPs mobile application include a community feed with user posts, an app discovery page showing installed apps on the device as well as community members apps, a direct messaging page allowing users to receive the answers and help they need, and a simplified profile page.