Summer 2021 Research Symposium

Abstract Book

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Army Research Program - Department of Defense

Title: The Difference between Confederate vs. Non-confederate Activity in a Social Media Experiment

Student Author: Lolo Aboufoul

Faculty Mentor (s): Dr. Samira Shaikh

College: College of Computing and Informatics

User activity on social media can be defined by the posts each user makes and the amount of interaction these posts receive. As part of a research study conducted by our team on a mock social media platform, a confederate user is one that is controlled by the team responsible for making posts as part of an experimental intervention. Confederates have the content of their posts dictated by the researchers as well as the time and date they should post it. Non-confederate users are those who are not involved in the creation of the experiment; rather, they are the main participants in the study. Confederate posts can sway the reaction of other users (non-confederates) in a certain direction depending on how instigating they are. Furthermore, confederate posts are carefully calculated and written with the intent of generating a reaction from users. For example, a confederate user could post about a certain topic using opinionated language. This post would contain such language because it is posted by users who are not participants in the study with the intent of studying the reaction these posts receive. The reaction received by non-confederate users can then be studied and results obtained from these experiments can help draw conclusions on how different users from varying political backgrounds, ages, and status react differently to the same post. In this study, it is hypothesized that confederate activity in heterogeneous groups will garner more activity and user reactions than those in homogenous groups.

College of Computer and Informatics REU

Title: Immersive Learning with Virtual Reality

Student Author: Aiden Lamar

Faculty Mentor (s): Dr. Aidong Lu

College: College of Computing and Informatics

Many forms of modern public education leave a lot to be desired by teachers, students and institutions. Current forms of education can be lacking in many areas such as: students interacting with the material, personalization that should be present in all education, 3D visualization of concepts, and cost effective tools and equipment for physical learning. Our approach to solving some of these problems involves the introduction of immersive learning into different areas of teaching. Immersive learning refers to the use of new technologies that can provide intuitive and personalized virtual learning environments to help students learn and practice their skills. In other words, immersive learning uses virtual or augmented reality to teach. Our research involves the development of two projects, one being the use of a VR game to train nurses, and the other being a collection of virtual physics simulations and labs to teach middle or high school physics students. The physics project includes a variety of different physics simulations built in Unity that demonstrate basic laws of motion and force vectors. The VR nursing game includes 3D environments where a nurse can familiarize themselves with putting on PPE safely, and assisting a virtual patient with preventive action. We plan to conduct an evaluation on these methods via having students compare the immersive learning techniques of both projects to traditional learning. We expect to demonstrate the cost, interactivity, and personalization advantages of immersive learning using VR.

Title: Evaluating Students' Perception of Online Learning Tools Utilizing 2-D Virtual Spaces

Student Author: Anna Stubler

Faculty Mentor (s): Dr. Nadia Najjar

College: College of Computing and Informatics

The COVID-19 pandemic led the majority of educational institutions to rapidly shift to primarily conducting courses through online, remote delivery. Across different institutions the tools used for online course delivery varied. They included traditional video conferencing tools like Zoom, Google Meet, and WebEx. They also included non-traditional tools like Gather Town, Gatherly, and YoTribe that utilizes 2-D maps to create virtual meeting spaces attempting to mimic real-world classroom experiences. These tools have additional features that support collaboration and mirror in-person interaction like collaborative white boards, voice and video chat triggered by proximity, and integrations like games and musical instruments that allow collaborative and social interactions. Our research focuses on examining if there is a difference in students' perceived experience when using a video calling tool that features a 2-D virtual space versus one that does not. We examined students' perception of such tools in different contexts to see if the type of activity they are doing (solo versus team) affects their perception of the tool. Two different pilot studies were conducted to answer this. The first involved surveying students in several computer science courses at UNC-Charlotte that piloted the use of Gather Town. The second study involved surveying students in the summer Research Experience for Undergraduates (REU) program in the College of Computing and Informatics at UNCC. We hypothesize that utilizing a tool that features a 2-D virtual space has benefits that are perceived by the students compared to the more traditional video conferencing tools.

Title: How to Identify Security-Critical Basic Blocks for Rewrites in Software Diversification

Student Author: Bennett Kahn

Faculty Mentor (s): Dr. Meera Sridhar & Dr. Harini Ramaprasad

College: College of Computing and Informatics

Due to limited resources and manufacturer neglect, IoT devices frequently contain software vulnerabilities. Malware scanners are common tools that can detect attacks such as return-oriented programming (ROP), where an attacker combines machine instructions (gadgets) of benign binaries on the system to execute various exploits, like remote code execution. Malware scanners are computationally intensive and, accordingly, impractical on IoT devices. In software diversity, developers attempt to reduce the likelihood of large-scale attacks by releasing multiple, semantically-equivalent rewrites of potentially vulnerable code, hoping that an attacker must craft a unique ROP payload (a string of addresses of various gadgets) for each code version.

In this paper, we attempt to identify which basic blocks (code sequences with single entry and exit points, and no jumps in execution) of a program's assembly code are most critical in software diversification for security, and how to identify these blocks. We define security-critical basic blocks as those that are susceptible to exploitation, which fall into two categories: Basic Blocks Type A produce gadgets commonly used in ROP attacks, while Type B contain the actual memory errors. We predict that rewriting these blocks across versions will render a payload unsuccessful on a large scale.

Software diversity is a popular technique in security but has yet to be attempted on IoT devices. We plan to use Connman source code (a lightweight network manager in IoT devices) as a testbed for developing general techniques for locating these basic blocks, using language-based security tools and techniques, like Exrop and taint analysis.

Title: Smart Home Co-Monitoring Student

Authors: Elizabeth Tran & Tailin Postema

Faculty Mentor (s): Dr. Heather Lipford

College: College of Computing and Informatics

With the rise of smart home devices, privacy and security issues are a major concern. Many smart home device owners often choose to share their devices with family, friends, and neighbors with the purpose of co-monitoring their homes in case of emergencies. Yet giving access to smart home devices puts people's privacy at risk, as current support for smart home access controls is overly simplistic, which limits the types of sharing users are comfortable with. The goal of this research is to explore privacy concerns and features in a system that allows people to configure sharing alerts and views of their smart home devices in emergency situations.

We are motivated to help manufacturers better understand users' needs and provide the necessary tools for smart home users to co-monitor their homes without any invasion of privacy. Through a participatory design study, we will ask pairs of users about particular scenarios relating to co-monitoring and discuss their privacy concerns. After going through each scenario, we will ask participants to build an app interface to configure the sharing of their smart home devices to better understand how smart home users want to allow friends and family to co-monitor their home in case of threats. The results of this study will reveal users' privacy considerations in sharing access to their smart home devices, requirements for a privacy-preserving co-monitoring system, and specific design features that meet user needs.

Title: Vulnerability Analysis and Mitigation of MIL-STD-1553 Communication Protocol

Student Author: Gavin Blankenship

Faculty Mentor (s): Dr. Chao Wang

College: College of Computing and Informatics

MIL-STD-1553 is a widely-used network protocol that was published by the United States Department of Defense in 1975. It was originally created for military avionics. The protocol is currently being used for many military and civilian applications because of its flexibility and easy adoption. MIL-STD-1553 assumes a serial data bus, upon which commands and data are transferred throughout the aircraft. The data transfer is always initiated by a bus controller and travels to a subsystem in the aircraft known as a remote terminal. The serial data bus is also used for status data request/response. For many years this protocol has been reasonably secure from attacks because of its physical isolation from the external world. Due to technological advances in connectivity, it has become a priority that operators/pilots can detect and protect the subsystems within an aircraft using MIL-STD-1553. Without the correct security measures in place, subsystems in the aircraft such as autopilot, GPS, missiles, and many other things are vulnerable to attacks. To determine the vulnerability within MIL-STD-1553, an implementation of the protocol was used to create a simulator of the protocol. From there, cyberattack methods will be put in place to reveal where the vulnerabilities are located within the program. Next, mechanisms will be explored to help detect cyberattacks against MIL-STD-1553. After the attacks are detected, mitigation mechanisms will be explored to protect MIL-STD-1553.

Title: Making The Truth Louder On Social Media

Student Author: Marley jenkins

Faculty Mentor (s): Dr. Mary Lou Maher

College: College of Computing and

Informatics

Misinformation is one type of fake news that refers to the unintentional spreading of false information, and this research focuses on mitigating the spread of misinformation on social platforms. We are investigating the differences between users' interaction tendencies on social media and developed 3 design principles to address these differences. These design principles are known as Contextual, Guidance, and Incentive awareness. The goal of the design principles is to help users and designers to provide interactive support for spreading more credible information and make the truth louder on social media platforms. In this project, we are developing prototypes and performing pilot studies to improve the design implementations and finalize a user study that will investigate the social media users of different interaction tendencies. From the information gathered from the pilot studies, we categorize participants into two groups based on their interaction habits: active and passive users - the active users have more sharing tendencies than the passive users. We intend to understand how those 2 types of users utilize the sharing functionalities on social platforms and how their motivation for spreading verified information differs because of their interaction tendencies.

Title: Developing Methods to Infiltrate Samba Servers and Replace Legitimate Data with Malware

Student Author: Mukund Ramakrishnan

Faculty Mentor (s): Dr. Jinpeng Wei

College: College of Computing and Informatics

Samba is a widely-used networking protocol that allows computers on a local-area network to send and receive files with each other. Research has shown that the Samba protocol is insecure, and that any individual with access to the client computer may be able to glean the data being sent and received between the client and the server. Our study aims to establish a proof-of-concept whereby legitimate packets being sent from a client to a server can be analyzed, and then new packets can be fabricated and sent to the same server, which would ultimately show that malware could be transmitted to the server by any individual with physical access to the Samba client. Our findings have so far demonstrated that this is not possible on a machine running the macOS operating system, as the processes responsible for the Samba connection are closely guarded by pseudo-user accounts specifically created by the system to run these processes securely. Our findings further suggest that we could use existing Samba utilities, on other operating systems such as Ubuntu and Windows, to explore the possibilities in using the connection to achieve our goal of injecting malware-containing packets in the stream. Different operating systems' security measures, when studied, allow us to further understand the ability of the client to attack the Samba-connected server.

Title: Addressing Conflicts in Diverse PLC Systems Using Data Provenance

Student Author: Taylor McDermott

Faculty Mentor (s): Dr. Thomas Moyer

College: College of Computing and Informatics

Smart buildings utilize Programmable Logic Controllers (PLCs) to manage automated processes. Cyber attacks may impair the functionality of smart building control systems because they can create conflicts in certain devices. A conflict is a violation of a system's defined safety and security policies. For example, a conflict arises when temperature sensors shared by a thermostat try to adjust the temperature differently. Identified conflict types are expressed as algorithms and written in Python code, enabling the PLC inputs and outputs that data provenance collects to be analyzed. Detected conflicts are mitigated by prioritizing certain actions over others using a set of superiority rules. These concepts and code have been tested using internal testbed data. This research intends to build upon this foundation by applying them to external datasets, specifically those taken from smart home environments and documented by the Center for Advanced Studies in Adaptive Systems (CASAS). Challenges include the specificity of smart building control system infrastructure, namely the diversity in sensors and required functions between different systems. This paper proposes approaching this task by modifying the format of external datasets and the code itself. Accomplishing this objective would show that conflict detection and mitigation capabilities built upon the concepts of defeasible reasoning and data provenance can be expanded to any PLC system, not just a specific lab scenario. The solution will be validated when running the CASAS data on the conflict detection and mitigation code yields expected results, specifically those that address known conflicts with accuracy.

CPCC-LSAMP

Title: Water Channel Characteristics

Student Author: Joseph Dickey

Faculty Mentor (s): Dr. Jerry Dahlberg

College: College of Engineering

Objective: The water channel has many similar characteristics as a wind tunnel, and as both these elements are a part of everyday modern life, these experiments can be applied to a wide range of practices, including renewable energy. The main objective of this research is to determine the overall flow uniformity of The University of North Carolina and Charlotte's Water Channel and map locations of non-uniformity at different motor frequencies. The research will also provide a database of the water flow velocity with respect to the speed of the turbine powering the water channel. The accuracy of the data collected will be determined based on limitations in the experimentation process as well as human errors that occur.

Method: Water Channel flow rate data will be collected using flow rate sensors and Labquest 3, a data-collection platform used to collect, analyze, and interact with data efficiently. The Labquest 3 will be attached to an apparatus that is specifically built to measure the flow at various locations throughout the test area of the water channel. Any discrepancies within the uniform flow rate data, if any, will also be included in the data. As modifications had been made prior to this testing, uniformity rates were expected to either be the same as they were before modifications or improved.

Conclusions: Through experimentation with The University of North Carolina at Charlotte's water channel, we will be conducting trials and recording data regarding the flow rate and velocity of the water. During our experimentation we will be able to determine what frequency the turbine needs to run at for specific velocities and demonstrate what locations of the test area are the most uniform for a given set of conditions.

Title: Cigar-Box Micro-Processing Unit

Student Author: Justin Perez

Faculty Mentor (s): Dr. Amirhossein Ghasemi

College: College of Engineering

Educational toolkits have been developed and applied to help students at all levels understand science and engineering concepts. An example of such devices is a Cigar-box micro-processing unit developed at the University of Michigan. Cigar-box micro-processing unit is a relatively low-cost haptic device that contains two linear actuators powered by DC motors, two faders, and linear potentiometers (for position sensing) attached to each of these actuators and three rotary control knobs. The whole system is controlled by an Arduino. The box connects to a PC via USB and can be controlled using Matlab/Simulink by installing some online packages.

This project aims to adopt the Cigar-box unit as an educational toolkit for a mechanical engineering course – Introduction to System Dynamics II- at UNC Charlotte. Specifically, we aim to demonstrate how changing different characteristics of a second-order dynamic system can change the system's response. To this end, the three knobs will be programmed to capture the values for the main parameters of the system (mass, stiffness, and damping). For the dynamic course, the analytical response of a dynamic system will be calculated for each of these values. Then, linear actuators will be programmed to demonstrate the response of the second-order system. We expect using this education toolkit to assist the students to better understand the basic principles of dynamics systems.

Title: Analysis and Visualization of Educational Materials

Student Author: Nicole Grapain-Delgado

Faculty Mentor (s): Dr. Erik Saule

College: College of Computing and Informatics

CS-Materials is a web application that enables Computer Science instructors to classify their pedagogical materials (lecture slides, exams, assignments, etc.) against the 2013 ACM/IEEE CS curriculum guidelines. The classification of the pedagogical materials will allow instructors to visualize how their materials align with national standards and other materials that have been entered in the CS-Materials database. As a result of classifying pedagogical materials, CS-Materials implemented a search feature that would allow instructors to discover materials that could be implemented in their course. Currently, the search function uses a hierarchical structure of the classification tree in order to estimate the similarity between two materials. In order to perform a search against a query, the similarity between two materials is computed by building a bipartite graph for each comparison made. However, as more users classify their materials, the performance of building a bipartite graph and comparing the classification entries will become inefficient, thus, another method should be explored to ensure scalability in the near future. Therefore, this project explores PageRank, a link analysis algorithm. PageRank has a lower runtime complexity as it requires creating only one graph that can be reused when performing the comparison in contrast to the current method. Thus, PageRank will be tested in the search function and we will analyze whether the algorithm returns useful data and if so, explore the options of adopting PageRank into the search function to ensure scalability as new users utilize CS-Materials.

Title: Cigar-box micro processing unit

Student Author: Maritza Perez

Faculty Mentor (s): Dr. Amirhossein Ghasemi

College: College of Engineering

Educational toolkits have been developed and applied to help students at all levels understand science and engineering concepts. An example of such devices is a Cigar-box micro-processing unit developed at the University of Michigan. Cigar-box micro-processing unit is a relatively low-cost haptic device that contains two linear actuators powered by DC motors, two faders, and linear potentiometers (for position sensing) attached to each of these actuators and three rotary control knobs. The whole system is controlled by an Arduino. The box connects to a PC via USB and can be controlled using Matlab/Simulink by installing some online packages.

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CTI's Summer Research Experience for Teachers (SRET)

Title: Comparing the Thermal Properties of Human Hair and Synthetic Hair

Student Author: Erika Williams (Science, Philip O. Berry Academy of Technology) and Lynn Roach (Civics and American History, West Charlotte High School)

Faculty Mentor (s): Dr. Scott Gartlan and Tracy Brown-Fox (Chemistry, Johnson C. Smith University)

College: College of Liberal Arts and Sciences

Understanding the science behind hair goes beyond the latest and stylish hairstyles that most women and men often wear. Women have been persuaded to adopt looks that require chemically and physically manipulating their natural fibrous biopolymer protein called keratin – polypeptide chains of amino acids such as glycine, alanine, and cysteine. In addition to this chemical and physical manipulation, women have also included wearing synthetic wigs or adding synthetic hairpieces. Synthetic polymers are used to fabricate wigs and weaves to resemble the appearance of natural hair. The close parallel between wigs and weaves to natural hair is primarily based on the chemistry and evolution of polymers (plastics) used to fabricate wigs and weaves.

This project involves comparing and understanding the thermal properties of human and synthetic hair utilizing high-tech instrumentation often used in thermal analysis. Thermal analysis is a branch of materials science where the properties of materials are studied as they change with temperature. Instrumentation used for thermal analysis includes a thermogravimetric analyzer (TGA) and differential scanning calorimetry (DSC). The TGA examines the change in mass with respect to temperature and environments (active - air and inactive - nitrogen). The DSC is a thermo-analytical tool that is widely used to study various temperature-induced transitions in many materials. Using experimental designs, SRET fellows will examine 1st and 2nd order transitions (e.g., melting, crystallizing, glass transition) and the heat degradation of the biopolymer in human hair and synthetic polymers used to fabricate synthetic wigs and weaves. Implications to race will be explored.

Keywords: synthetic hair, natural hair, polymers, thermal analysis, race

Title: Looking at Integration Stories from Clear Creek Elementary: A Study Linking the Subscription Schools of the Past to Today

Student Author: Jashonai Payne

Faculty Mentor (s): Dr. Janaka Lewis and Scott Gartlan

College: College of Liberal Arts and Sciences

The school in which I teach, Clear Creek Elementary, is the last Charlotte-Mecklenburg Schools' school on the stretch of Albemarle Road, going towards the city of Albemarle, NC in Stanly County. Clear Creek Elementary was built in 1924, before the national push towards integrating public schools. A brief history is displayed on the school's website indicating that this area was quite rural. The schools that predated Clear Creek were called "subscription schools." These schools required a tuition to be paid in order to satisfy the teacher's monthly salary of $25.00. The subscription schools seemed to work around the harvest dates, only giving these students about four months of schooling each year. There were other schools that followed the subscription schools, one school was operated by the Arlington Baptist Church in neighboring Mint Hill, NC, built in 1901. I wonder how these former subscription schools influenced Clear Creek Elementary and its population. Looking at old photographs of the staff, it seems to have been primarily White for many years. Was the initial population of students and teachers all White when the school opened? What was the integration story of Clear Creek Elementary? Was it a smooth and seamless transition or was there great resistance from the community? In addition to looking at photographs and artifacts at the school, I plan to interview former students and parents of Clear Creek Elementary to get first-hand accounts of these experiences.

Key words: Clear Creek Elementary, subscription schools, rural schools, integration stories, White, Black, interviews, photographs

Title: Ambitions of the Pottstown Community

Student Author: Kimberly Palmer, English, Merancas Middle College High School

Faculty Mentor (s): Dr. Scott Gartlan and Janaka Lewis, English, UNC Charlotte

College: College of Liberal Arts and Sciences

What drew me to Stories of Education and Integration in Charlotte and across the South, are my experiences with the Charlotte Teachers Institute. Each year that I participate, I set a goal for myself prior to beginning, which is to make the curriculum I teach fit my students and not vice versa. I want to find out who our education is targeting, as well as the intended outcome of learning the pre-written literature curriculum. Education is supposed to reflect our diverse students and this is something that the education system is continuously failing in, especially with the erasure of local black history within educational programs. My goal as a literature teacher is to disrupt the traditional text and 'universal white education', as well as create everchanging lessons that reflect each student that I teach. My school is located in south Huntersville, which is the location of the Torrence-Lytle School, formerly known as The Huntersville Colored School. This school closed in 1966 due to integration mandates and all students being reassigned to racially integrated schools. I hope to explore the historically black Pottstown neighborhood that the school is located in, the closure of the school due to integration decree, and how the erasure of this historically black school and its rich, black-centered curriculum, affected the education of minority students. It is important to note the impact that these prominent minority neighborhoods have and the importance of preservation for the continued education of future generations, especially for schools in the surrounding areas.

Title: The Legacy of Busing in Charlotte, NC: How Did Busing and School Desegregation Affect the Coulwood Community?

Student Author: Mary McElhaney, 7th Grade Social Studies, Mountain Island Lake Academy

Faculty Mentor (s): Dr. Janaka Lewis and Scott Gartlan

College: College of Liberal Arts and Sciences

The Coulwood Community of Charlotte was formed in 1953 and is still in existence today. The first homes within the area between the Brookshire Freeway and Mount Holly Road stretched along Gum Branch Road and Cathey Road. Later Birchwood and Sedgwick Roads. In order to accommodate all these families and their children, Paw Creek Elementary School was formed in 1958, which still serves the community to this day. In later years, additional schools were added to the area: Mountain Island Lake Academy, River Oaks Elementary School and Mountain Island Day. Even after the famous Supreme Court Case Brown v. Board of Education was decided in 1954, many schools still remained segregated until the 1970s. Then in 1971 the Supreme Court ruled in the Swann v. Charlotte Mecklenburg Board of Education case that busing students to different schools in an effort to promote racial integration was an appropriate remedy. From the early 1970s through the 1990s, Charlotte-Mecklenburg Schools began to show the promise of racial integration discussed in the Swann case. However, in the last twenty years, beginning with the federal order to end busing in the 1999 case of Capacchione v. Charlotte-Mecklenburg Schools, evidence suggests that schools are resegregating, with some schools more segregated than pre-Swann. This research examines the demographics of the early Coulwood Community and surrounding schools over time, including before busing was ordered in the Swann case, during the busing period, and after busing ended in order to understand how the Coulwood has changed over time.

Key words: Coulwood Community of Charlotte, busing, segregation, integration, Paw Creek Elementary, Mountain Island Lake Academy

NanoSURE REU

Title: An Integrated, Field-Transferable Biosensing Platform for Surface Enhanced Raman Spectroscopy (SERS)- Based Asymptomatic Malaria Detection

Student Author: Abbey Oliver

Faculty Mentor (s): Dr. Swarnapali Indrasekara

College: College of Liberal Arts and Sciences

Malaria is a highly contagious disease that accounts for hundreds of thousands of deaths each year, especially burdening low-resource countries in Africa and Southeast Asia. There is an urgent need for time-efficient, sensitive, and low-cost diagnostic testing to control its spread. Current methods for malaria diagnosis, such as light microscopy and rapid diagnostic testing, only detect malaria in the symptomatic contagious phase and are either too expensive, slow, or imprecise. The Indrasekara research group has previously developed an optical biosensor that targets Pfs25-mRNA, an asymptomatic malaria parasitic biomarker, using a SERS-based nucleic acid sandwich hybridization assay. The capture probe is functionalized to a magnetic bead which can be isolated from hybridization solutions for analysis. However, this magnetic separation workflow requires extensive time, micropipetting expertise, and expensive instrumentation that clinics in low resource areas are not likely to have. Here, we create an integrated, user-friendly, cost-effective integrated platform for carrying out the sandwich hybridization assay to detect malaria in the asymptomatic stage. This is done by (1) developing a capture probe-functionalized glass dipstick sandwich hybridization assay, (2) implementing a gold nanostar-enabled photothermal blood lysing system, requiring no extra equipment or chemicals, and (3) taking measurements with a portable, handheld Raman spectrometer and creating an accompanying machine learning model to analyze the spectral data. These three components assemble as an integrated platform which could be delivered to clinics as an affordable testing kit to provide fast and sensitive diagnosis of malaria, thereby minimizing its spread.

Title: Synthesis of POSSP-functionalized Silver Nanoparticles for Photoinactivation of Antimicrobial Resistant Bacteria

Student Author: Aliyah Aguilar

Faculty Mentor (s): Dr. Vivero-Escoto

College: College of Liberal Arts and Sciences

The world is facing an antibiotic resistance crisis that will eventually result in millions of deaths across the world. Currently in the United States alone, there are about 2.8 million people per year who contract an infection associated with antibiotic resistant pathogen. This current health emergency calls for the critical need to develop effective treatments against antibiotic resistant bacteria. The overall goal of this research is to expand the application of polyhedral oligomeric silsesquioxane porphyrin (POSSP) molecules combined with silver nanoparticles (AgNPs) towards the elimination of antibiotic resistant bacteria. We aim to investigate the antibacterial activity when the combination of POSSP and AgNPs are activated with light. In particular, during this summer research experience, our goals are to synthesize a bifunctional POSS molecule containing a thiol and amine functional groups and modify the POSS molecule with porphyrin. This POSSP derivative will be used to modify the surface of AgNPs. Several analytical techniques will be used to characterize the POSS compounds such as FT-IR; 1H-, 13C- and 29Si-NMR, UV-vis spectroscopy and MALDI-MS. The synthesis of AgNPs is carried out using a citrate-mediated synthesis. The nanoparticles will be characterized using DLS, TEM and TGA.

Title: Using Nucleic Acid Nanoparticles Complexed with Polyamidoamine Dendrimers to the Enter Cells and Silence Proteins

Student Author: Annaliese White

Faculty Mentor (s): Dr. Kirill Afonin

College: College of Liberal Arts and Sciences

Nucleic acid nanoparticles (NANPs) consist of DNA or RNA nanoscaffolds and serve as a platform to carry siRNA units. Due to their ability to carry siRNA units, NANPs have the potential to be used for gene therapy. NANPs need a carrier due to nuclease degradation in the bloodstream and to enter cells, so we use polyamidoamine (PAMAM) dendrimers. Dendrimers are hyper-branched polymeric structures and have the potential to be effective carriers for NANPs, as shown in a previous study using generation 5 dendrimers. In our studies, we will broaden the number of generations studied and utilize generations 3-7 PAMAM dendrimers as carriers. The PAMAM dendrimers bind to the NANPs due to electrochemical interactions between the dendrimer's positively charged terminal amino group and the nucleic acid's negatively charged phosphate backbone. An increase in generation also means an increase in the dendrimer's overall size and number of positively charged surface groups. From initial binding assays, an increase in the generation of dendrimers bound to NANPs shows a more neutral charge. Binding ratio is important, as neutrality indicates the optimal binding between the two structures. Using fluorescently labeled NANPs and NANPs functionalized with siRNAs designed against green fluorescent protein (GFP), we can check cellular uptake and gene silencing using MDA-MB-231 cancer cell line. By studying these characteristics of dendrimers, we can examine the effectiveness of dendrimers as carriers and which generation holds the most potential as the best carrier.

Title: Analyzing the Compositional Exchange of Nucleic Acid Strands within a Cube Nanoparticle

Student Author: Doaha Awad

Faculty Mentor (s): Dr. Kirill Afonin

College: College of Liberal Arts and Sciences

Nucleic acids are found in all cells and have been used as components of therapeutic drugs in recent years, showing promising results for the treatment and detection of diseases. In this study, we propose using nucleic acid nanoparticles, referred to as NANPs, as a model for further understanding the composition of a specific nucleic acid structure. NANPs are synthesized with strands of RNA/DNA, and due to conventional Watson and Crick base pairing, complementary bases bind and create the structure of the nanoparticle. We will be investigating the exchange of varying components of these structures to identify the possibility and rate of the associated interchange. It is known that a hybrid nanoparticle is possible with both RNA and DNA strands, however, if these strands will willingly construct into a hybrid conformation when introduced with a complementary strand has not been investigated. This research will focus on the ability for cube nanoparticles to undergo strand exchange after self-assembly using RNA/DNA cubes with a fluorescent duplex, composed of a GFP strand and an Alexa 488 fluorescent. The exchange was visualized and measured for the allotted rate of the exchange. It is expected that the rates of the exchanges will not be equal and that some components will take longer to change, if at all. If these nanoparticles can exchange a component of the already constructed cube, this can potentially eliminate unwanted responses and reactions of the cell and improve current therapeutic systems.

Title: Synthesis and Characterization of II-VI Organic/Inorganic Hybrid Materials

Student Author: Eric A Tkach

Faculty Mentor (s): Dr. Tom Schmedake

College: College of Liberal Arts and Sciences

Organic/inorganic hybrid materials have potential applications in semiconductor and electrooptic technologies including photovoltaics, solid-state lighting, and photodetection. To realize these potential applications, improved synthetic methods are needed to increase the size and quality of the crystalline hybrid materials. In addition, new synthetic methods for electronically doping the hybrid materials are critical for the development of this field. In this research, new synthetic methods were explored with the objectives of increasing the size and conductivity of the resulting hybrid materials. Previously, the II-VI organic/inorganic hybrids were synthesized in a bomb reactor (acid digestion vessel) in a furnace. In this research, the reaction was done in a temperature and pressure controlled high-pressure reaction vessel, under a wide range of conditions in an inert Nitrogen atmosphere. The composition of the hybrid material in this research was $ZnTe(en)0.5$ doped with varying percentages of copper added as an electronic dopant ((en)=ethylenediamine). These hybrid materials are composed of microlayers of group II-VI inorganic elements with an organic molecule like ethylenediamine or propanediamene in between. The crystallography of the produced hybrid crystals was characterized using x-ray diffraction and compared with other phases of $ZnTe(en)0.5$ and other hybrid materials.

Title: Using Thiazolothiazoles as Photocatalysts in a Variety of Different Reactions

Student Author: Jackson Barrett

Faculty Mentor (s): Dr. Michael Walter

College: College of Liberal Arts and Sciences

Thiazolothiazole (TTz) compounds as photocatalysts is a novel idea, that could effectively become a cheaper alternative to more expensive metal-based photocatalysts. TTz compounds stand out from other organic photocatalysts because their versatility in other applications, such as chromogenic windows and organic based batteries. The specific TTz derivative that we have studied, dimethyl derivative (Me2TTz2+), has shown to be 60-70% efficient in photochemically driving the free radical carbon-carbon bond formation between an isopropyl BF3K and N-benzylidine-aniline. Although the reactions are conducted in organic solvents, a slight increase in the water content of the sample was found to increase the yield. These experiments have not been conducted at the optimal absorption wavelength of 395 nm, instead at 420 nm. Additionally, the mechanism is unknown and must be found. The photocatalytic efficiency is also unknown and quantum yield experiments must be used via a comparative method using ferrioxalate actinometry. The versatility of the TTz compounds as photocatalysts is also unknown and different reactions must be explored to assess the scope. All the reactions conversion rates will be characterized by GC-MS and 1H-NMR.

Title: [3]Radialene Anolytes for Aqueous Redox Flow Batteries

Student Author: Jackson Hardister

Faculty Mentor (s): Dr. Christopher Bejger

College: College of Liberal Arts and Sciences

Renewable energy sources, such as wind or solar, can be coupled to vanadium redox flow batteries (VRFBs). These secondary batteries balance inconsistent energy production by "banking" power in the event of low yield. VFRBs are comprised of two tanks that each hold an electrochemically active solution of vanadium ions, pumps, and a central electrochemical cell that enables charging, discharging, and ion exchange. VRFBs use vanadium salts undergoing redox reactions in an acidic solution to store energy, which can be environmentally harmful in the event of a failure. We are investigating organic compounds as charge storage species for use in aqueous RFBs. Specifically, [3]radialenes are a promising alternative to traditional inorganic salts. We prepared hexa(2-pyridyl)[3]radialene and studied its electrochemical properties in aqueous solutions. Cyclic voltammetry was performed with a 2mM radialene solution. The compound undergoes a single, irreversible reduction event in pH neutral solutions of 0.25 M NaCl. This reduction becomes more pronounced and is quasi-reversible in 1M aqueous NaOH. Presumably, the radical anion formed via reduction is protonated upon formation. This suggests that hexa(2-pyridyl)[3]radialene is not an ideal anolyte for an aqueous redox flow battery, as it lacks the ability to cycle between its neutral and radical anionic states. Synthetic efforts are currently underway to design more robust radialene anolytes.

Title: Regeneration of Compartmentalized Neural Axons by Magnetic Fields

Student Author: Jameese Dunham

Faculty Mentor (s): Dr. In Hong Yang

College: College of Engineering

Neural injuries, such as paralysis, cause the disconnection of the axon which then fails to send out brain signals to the dendrites of adjacent neurons. Neurons in the central nervous system (CNS) fail to regenerate axons after injuries due to the diminished intrinsic axon growth capacity of mature neurons. Past research attempted to trigger regeneration of neural axons through the growth cone. Growth cone supports the extension on the axon by targeting the synaptic terminals. However, if the regeneration is not guided, the growth cone branches will grow disorganized and cause neuroma, the thickening of tissue around a nerve. Nerve gaps require a graft to bridge the defect and guide the neurons to prevent the formation of a neuroma. Repetitive magnetic fields can be used to guide the growth cones and fill in the gaps to prevent the painful tissue inflammation. In this experiment, magnetic fields at various frequencies will be used to test the theory if they can regenerate the length of the axon to a further distance. This research will be applied to the rat brain of a fetus. To do this, fabricated compartmentalization will contain the regeneration of the axons through the chambers of the PDMS (polydimethylsiloxane). PDMS microfluidic devices helps with cell identification and isolation for cell culture applications. The purpose of this study is to establish what effect repetitive magnetic fields will have on regenerating the growth cone of the synaptic terminals in an organized manner to close the gap between injured neurons.

Title: Investigation of the Roles of Catalysts in the VLS Growth of Si-based Nanostructures

Student Author: Nichole Cassell

Faculty Mentor (s): Dr. Haitao Zhang

College: College of Engineering

To realize the large-scale applications of nanomaterials in manufactured products, it is important to understand the mechanisms of the controlled growth of nanostructures. Vapor-liquid-solid (VLS) process has been the most successful vapor-based growth method for a variety of one-dimensional nanostructures with the assistance of catalyst particles. In conventional VLS processes, the role of the catalyst(s) is to: accommodate the vapor precursors, form the nanosize seeds, and guide the growth of the nanostructures, while not participating in the production of the vapor precursors. This study discloses a new role of the catalyst(s) in enhancing the reactions and promoting the formation of vapor precursors from solid sources, which are otherwise challenging to vaporize without applying ultrahigh heating temperatures. The roles of the different catalysts (e.g., Te, Cu, and Au) were explored in the growths of Si-based nanostructures, including SiOx nanowires and Si2Te3 nanolayers. These growths were performed using a chemical vapor deposition method. The as-synthesized samples then were analyzed using scanning electron microscopy for morphologic characterization and energy-dispersive X-ray spectroscopy for compositional analysis. The effects of other growth parameters on the: precursor formation, vapor transportation, composition control, and morphology control of nanostructures were also demonstrated. The new growth mechanism using the catalyst(s) could promote the nanomaterial growth at lower growth temperature and lower cost making it more compatible for device fabrications.

Title: Nuclease-Driven Assembly of Nanoparticles

Student Author: Terry Dickson

Faculty Mentor (s): Dr. Kirill Afonin and Damian Beasock

College: College of Liberal Arts and Sciences

Nuclease-driven assembly uses nucleic acids, DNA and RNA, due to their ability to react to the environment in a dynamic manner allowing for many functionalities. Furthermore, this process allows for shape-switching, controllability, and many additional functionalities. We are looking at the concept of deriving cubes and anti-cubes by disassembling duplex nanoparticles using different enzymes. This could potentially be a very beneficial phenomenon that has little research behind it thus far. We studied this phenomenon by taking hybrid duplexes and adding RQ1 RNase-Free DNase (DNase) to degrade DNA and produce an RNA cube or add Ribonuclease H (RNase H) to degrade the RNA to produce a DNA cube. A possible advantage of duplexes is the stability, which means that this could happen at physiological temperatures, simplifying the process. This is enabled by the optimal conditions the nucleases work at, along with all strands releasing at the same rate. We want to derive cubes because they have significantly different immunological effects than duplexes. RNA cubes can trigger very strong immune responses, showing how vital shape is to the immune system. Ultimately, we want to better understand the process of deriving these cubes from hybrid duplexes. Kinetic characterization showed how the concentration of the cubes changed over time by adding enzymes and taking time points on native-PAGE gels. Native-PAGE's are commonly used to confirm assembly, but in this case, also to compare data of different molecules and/or time points. These gels, along with agarose gels, were also used to characterize and compare the RNA and anti-RNA cubes, show the digestion and assembly of the cubes, and many other characterization details. Conclusively, this gives us a forthright method to create cubes and anti-cubes and could potentially have a huge impact on medicine, and science as a whole.

OUR Summer Research Scholar Program

Title: Can Restored Saltmarshes Support Macroinvertebrate Communities Similar to a Natural Reference?

Student Author: Aashiana Patel

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

College: College of Liberal Arts and Sciences

Saltmarshes provide habitat and food for marine invertebrates and fish. Rising sea-levels and coastal development contribute to the deterioration of saltmarshes and the communities they support. Marsh restoration projects, like the Lake Hermitage Marsh Creation Project in Plaquemines Parish, Louisiana, are aimed at mitigating habitat loss and protecting coastal communities. Macroinvertebrate communities are important because they play key roles in the food web and nutrient-cycling processes. Thus, they are indicators of overall marsh health. The objective of this study is to compare macroinvertebrate communities at two restored marshes in Lake Hermitage relative to a reference marsh. We hypothesize that, initially, the more established marsh will have greater diversity than the restored marshes (created three years prior to sampling), but over the course of this study (2018-2021) all sites will support similar macroinvertebrate communities. This presentation includes the results of samples collected using nylon mesh bags filled with dried vegetation deployed at varying distances from the marsh edge (1, 10, 25, 50 and 100 m) for ~2 months in 2018. Samples were sorted, identified to the lowest possible taxonomic group, and counted. Preliminary results suggest that communities across the three sites are similar along the edge and start to differ at distances farther inland. The most abundant groups are in the Phylum Nematoda (roundworms), followed by Subclass Acari (mites and ticks) in the Phylum Arthropoda. Future steps will include completing the 2018 samples and evaluating marsh vegetation and altitude to determine what factors may be driving the differences in communities inland.

Title: Synthesis, Characterization, and Self-Assembly of POSS-Porphyrin Derivatives

Student Author: Abbe Eliasof

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

College: College of Liberal Arts and Sciences

Photodynamic therapy (PDT) is a form of treatment that utilizes light, oxygen, and a photosensitizer to form reactive oxygen species, leading to apoptosis and/or necrosis in cancer cells. Some photosensitizers may aggregate in solution to form ordered nanostructures with enhanced optical and electronic properties. Porphyrins are an example of photosensitizers that self-assemble to form aggregates in aqueous solutions. However, due to their hydrophobicity, the aggregates are irregular and often result in a decrease in their phototherapeutic properties, which is related to the self-quenching effect. Polyhedral oligomeric silsesquioxane (POSS) is a modifiable molecule that can be used as a scaffold to build porphyrin-based nanoparticles. POSS can behave as spacers between porphyrins in the framework of the nanoparticles, leading to enhanced phototherapeutic performance. In this project, the synthesis and characterization of two POSS-Porphyrin molecules will be carried out. POSS with two different substituents, phenyl or isobutyl, will be utilized. We hypothesize that the substituents will influence the formation of nanoparticles through two distinctive mechanisms. Different analytical techniques will be used to characterize the POSS-Porphyrin compounds, such as FT-IR, ^{1}H-, ^{13}C-, and ^{29}Si-NMR, UV-Vis spectroscopy, fluorescence spectroscopy, and MALDI-MS. The self-assembly of these molecules will be studied using the precipitation method. The nanoparticles will be characterized using DLS, TEM, UV-Vis spectroscopy, and fluorescence spectroscopy. We hypothesize that POSS-Porphyrin nanoparticles will show better photo-physiochemical properties than porphyrin nanoparticles.

Title: Rumors and Rations: Coverage of German Internees at Hot Springs and What They Ate

Student Author: Abigail Barrett

Faculty Mentor (s): Dr. Heather Perry

College: College of Liberal Arts and Sciences

On April 6th, 1917, the United States entered World War I; as part of the plan to win the war, the government supported meatless and wheatless days as well as encouraged women to sign food conservation pledges. The U.S. entering WWI also led to a rise of xenophobia against Germans; seeing non-naturalized German-Americans, and German merchant sailors as a possible threat to security, the United States government put them into internment camps. One of the many internment camps opened on July 8th, 1917, in Hot Springs, North Carolina. The internment camp became a source of gossip for those living in Hot Springs and the surrounding communities. A story that held more interest to the public than any other involved how many meals internees got a day, what they ate, how much it cost to feed them, and how the women in Hot Springs reacted to the news. The stories garnered so much national attention that Herbert Hoover, director of the U.S. Food Administration, commented on them. Rations at Hot Springs became a prevalent story because it capitalized on the experience of the everyday person and exploited the underlying anti-German sentiment of the time. Focusing on local newspapers and propaganda posters, I explore why a story surrounding food poisoned the relationship between locals and German internees more than any other rumor? And why newspaper articles focus on women's reactions and not men's?

Title: Outtakes, Slogans, and Message Characteristics in Black Lives Matter Tweets: Interviews with Supporters

Student Author: Alex Arias

Faculty Mentor (s): Dr. Tiffany Gallicano

College: College of Liberal Arts and Sciences

This study examines outtakes, slogans, and message characteristics in the context of the Black Lives Matter movement following George Floyd's death. Outtakes are a category that refers to people's attention to a message, understanding of it, and retention of it (Lindemann, 2002). Black Lives Matter supporters reflected on the most memorable messages on social media, which is significant to public relations as the first academic study of its kind to adopt this approach. Supporters were also asked to share their reactions to prominent slogans and discuss how they would interact (or did interact) with these slogans on social media and why. This study is only the fourth empirical study about slogans in the public relations literature. Finally, participants examined three groups of social media messages, which each contained three messages sharing various similarities and differences. They discussed their reactions to the nine messages and explained how they would interact with these messages on social media (including only reading them). The heuristic-systematic model was used to relate participants' insights to existing theory. A total of 25 participants were interviewed via Zoom. Following the transcriptions, NVivo 12 was used by two coders to organize the data into research questions. Next, thematic analysis was applied through an iterative process of identifying and refining themes in response to the research questions (see Miles & Huberman, 1994). This investigation matters not only due to the theoretical contributions but also due to the role of social media as a platform for social media activists to circulate messages.

Title: Racial Consciousness, Uplift, and Justice in Harlem Renaissance Poetry

Student Author: Alexandria Schultz

Faculty Mentor (s): Dr. Malin Pereira College:

College of Liberal Arts and Sciences

Throughout the history of civil movements pursuing liberty for marginalized peoples in America and beyond, poetry stands out as an effective and widespread vehicle of advocacy. The Harlem Renaissance of the early 1920s to the late 1930s demonstrated an exceptional assemblage of activists and artists, many of whom were unified by their attempts to uplift their race through writing. By tracing the threads of racial consciousness, uplift, and justice through the poetry of Langston Hughes, Countee Cullen, James Weldon Johnson, and Carrie Williams Clifford, this paper explores the development of a black aesthetic expressing their intersectionality, that advances recurrent themes such as the reclaiming of Black history, promoting education, and advocating for civil rights. Through analysis of Johnson's "Fifty Years," Cullen's "From The Dark Tower," Clifford's "Marching to Conquest," and Hughes' "Let America Be America Again" and other relevant works, these topics will be interrogated. Harlem Renaissance poetry builds the infrastructure of mid to late twentieth century outpourings of work like the Black Arts Movement and into the first two decades of the twenty-first century, which some have termed a third "Renaissance" of poetry and art. An exploration of the implications of the aforementioned tenets in modern American society and in Black poetry since the Harlem Renaissance serves as a secondary goal. Enduring ripples of racism towards African Americans in the United States remain to be extinguished through contemporary creativity and advocacy, therefore investigating past themes of revolution and restoration will inform new paths to achieve authentic and lasting justice.

Title: The Effect of the 6th and 7th Runner on Team Cross Country Performance

Student Author: Ali Eltohami

Faculty Mentor (s): Dr. Doug Hague

College: College of Data Sciences

The aim of this research is to create a model that can predict a high school cross-country team's performance. In this sport, teams have 7 runners that receive a ranked score with the top five scores being added together and the lowest total winning. Team performance is a unique interaction of individual performance (and uncertainty) and the system for scoring high school cross country results. One of the unique features is how the 6th and 7th runners may influence results. Performance data for each individual runner will be used as input to study variation in the team placement due to uncertainty in the individual runner predictions. Monte Carlo simulation, which relies on multiple random samples in order to account for various outcomes, is utilized in this research to explore the interaction between individual uncertainty and overall team placement at a meet.

Title: Exploration of Silanediols as Protease Inhibitors

Student Author: Almira Ahmed

Faculty Mentor (s): Dr. Tom Schmedake

College: College of Liberal Arts and Sciences

Silanediols are a class of compounds that contain a silicon atom with two hydroxyl groups attached. They are analogous to geminal diols in organic chemistry, the hydrated form of a carbonyl compound. Silanediols have been proven effective at inhibiting several important proteases, including AChE (serine), HIV protease (aspartic), ACE (metalloprotease), and thermolysin (metalloprotease). Proteases are enzymes that can break down specific proteins in the body. Protease inhibitors can be used to slow down or stop unwanted protease activity, and they have been used in a variety of clinical settings including fighting HIV, hepatitis, and other viral infections. A comprehensive survey of the silanediol literature was conducted to understand the role of silanediols in the inhibition of proteases. A search of the topic "silanediol AND protease" on SciFinder produced 57 hits including 33 journal articles. A recurring theme throughout these papers was an emphasis on the structural differences resulting from the Si/C or Si/P switch, silicon exhibits higher covalent radii and longer bond length. Silanediols bind tightly with active sites of certain proteases through hydrogen bonding. They produce a low IC50 value (14 nM) when inhibiting a protease such as ACE, low IC50 values are more potent. Silanediols can also cross cell membranes, deliver antiviral effects, and are almost as effective as currently available pharmaceutical agents. The next step for silanediol inhibition is to find other enzymes and classes of proteases that can be effectively inhibited by silanediols.

Title: Synthesis of Thiazolothiazole Based Covalent Organic Frameworks and Their Electrochemical and Photochemical Properties

Student Author: Andrew Brotherton

Faculty Mentor (s): Dr. Michael Walter

College: College of Liberal Arts and Sciences

Improving catalysis is a major goal in cleaner and more efficient energy production. Thiazolothiazole (TTz) derivatives have been used in solar cells, biosensors, chemical sensors, redox flow batteries, and photocatalysis. The TTz core moiety is rigid, planar, aromatic, and highly fluorescent, demonstrating great electronic bridging capabilities where varying the side groups, pyridine or aniline, there can be observable changes when reduced or oxidized. The low redox potentials, absorption in the long UV range, and large quantum yields allow for unique electrodynamic and photodynamic properties that could be used to sense environmental changes, like pH changes or large ions, or transfer energy, like used in catalysis of water splitting and carbon fixation or Forster Resonance Energy Transfer (FRET) to sense substrates. Improved catalytic properties can be seen when the TTz is incorporated in a Covalent Organic Framework (COF) where the substrates can be isolated within the pores, due to larger surface area with the substrates compared to a lack of in normal organic polymers, and the reaction rate can increase, effectively lowering the time and energy used. Earlier TTz COFs have demonstrated properties in the heterogeneous catalysis of water splitting but could be enhanced by a novel alkylation of the TTz core, creating increased interactions with water and extended lifetimes of excited states where the original COF had difficulties. With relatively few synthetic steps and using organic molecules, these catalytic improvements can help create green energy production for the future.

Title: Reconstructing Patient-level Data from Aggregate Statistics for Covid-19

Student Author: Ashley Bang

Faculty Mentor (s): Dr. Liyue Fan

College: College of Computing and Informatics

Microdata consists of individuals' attributes that contain information specific to each respondent that can be used to compute aggregated statistics and to conduct fine-grained analysis. An instance of their use is seen in county based Covid-19 statistics, in which a collection of attributes are taken upon each diagnosed patient's age, race/ethnicity, gender, and zip code. Through this public domain, we investigated whether or not certain patients' microdata can be reconstructed to enable fine-grained analysis. The reconstructed patient-level data must be consistent with published statistics. To this end, constraints were created to narrow down the number of possible solutions that would be calculated using an SAT(satisfiability)-based constraint solver. Specifically, a Constraint Satisfaction Problem (CSP) was created by setting up binary variables that would encode patient-level attributes, e.g., age, gender, zip code, and defining aggregate constraints for published statistics. The constraint solver software used to compute the solution is known as Sugar. Solving the constraint satisfaction problem in the Sugar software reveals the number of patient-level data combinations that meet the constraints. The reconstructed data can then be utilized for a wide variety of fine-grained analysis that would provide more research opportunities and insights into Covid-19 in Mecklenburg county.

Title: Social Media in Society

Student Author: Audrija Bhattacharya

Faculty Mentor (s): Dr. Samira Shaikh

College: College of Data Sciences

The purpose of this project is to answer whether a bot can be created to fill the roles of confederate users on the pseudo-social media platform Community Connect, set up by the Social Media in Society research project. This contributes to a larger goal of analyzing the engagement patterns of social media users based on the political motivations of the social media posts. According to the US Government's Office of Cyber and Infrastructure Analysis, bots are programs that vary in size depending on their function, capability, and design; and can be used on social media platforms to do various useful and malicious tasks while simulating human behaviour. In other words, bots use various methods, such as data analytics and artificial intelligence, to replicate the behaviors of human users on social media platforms. In this project, a bot will be created using the open source conversational AI platform named Rasa. In this project, posts made by confederate and non-confederate users are being analyzed. The results of this analysis are being used to script this conversational AI bot to automatically post pre scripted posts onto the platform in order for the researchers to analyze changes in engagement from human users.

Title: Advanced Measurement Techniques for 3D Metal Printing

Student Author: Benjiman Harvey

Faculty Mentor (s): Dr. Kosta Falaggis

College: College of Engineering

Measurement techniques always have their errors and with the research that we have been doing over these past few weeks is to help lower the error on non-traditional measurement techniques when working on metal 3d printers. We have been looking at many different software's on both computers and on phones, testing to see which software will give the most accurate results. The main topic we have been looking at, is using Structure from motion photogrammetry techniques to help lower these errors in measurement. Structure from motion photogrammetry is a method used to create a 3d model of an object using different angled 2d images. The way we have done this is through computer open-source software such as Matlab, Meshroom, Colmap, and Regard3D. Along with looking at Structure from motion photogrammetry, we have also looked at basic 3d scanners which can be downloaded on both iOS and android phones. These scanners have you go around the object utilizing the many sensors on the phones such as LiDAR and True depth to accurately depict and build a model. Some of the software we have looked at on our phones are, Qlone, Canvas, Trnio, Scandy Pro, and ItSeez3d. So far what has helped us the most has been with the open-source computer software, and mainly using MatLab and Meshroom to help the greatest with our findings.

Title: Motives for Volunteerism Amongst Different Age Groups

Student Author: Breanna Duquette

Faculty Mentor (s): Dr. Jaclyn Piatak

College: College of Liberal Arts and Sciences

Volunteer programs are structured to appeal to different motives that compel individuals to participate, so that they can attract and maintain volunteers for their cause. The Volunteer Functions Inventory (VFI) is an instrument aimed at assessing the main motives of volunteers including values, understanding, social, career, protective, and enhancement motives. These six functions will be the focal point of survey response analysis from volunteers belonging to a grassroots advocacy organization whose goal is to pass national policies that address climate change. The national nonprofit relies on attracting and training volunteers who will help their cause by building local political support and connecting with leaders and officials at the local and federal level. Using a survey of their volunteers, we examine how age corresponds to volunteer motives. The purpose of this study is to examine how volunteerism amongst younger volunteers compares to motives of older volunteers. Are younger volunteers more motivated by the likelihood of an issue affecting them personally, or is there another factor that compels their involvement? OLS regression models for each motive show how age and other factors shape volunteer motivation. Findings illustrate why young people support certain causes and give their time. The results of this study have implications for volunteer programs as they shift their structures to appeal to younger generations as they become the dominant volunteering community.

Title: Annotating Gene Ontology GO terms to Examine Heat-Tolerance in Tomatoes

Student Author: Bryan Zavala-Martinez

Faculty Mentor (s): Dr. Robert Reid

College: College of Computing and Informatics

As climate change continues to pose a threat throughout the world, researchers are finding new ways to adapt to the ongoing changes in the agricultural field. Acute heat stress in particular threatens plant and crop productivity if excessive heat occurs during pollination. In our research we focus on the tomato plant (Solanum Lycopersicum), being one of the most in-demand crops in the world. For tomatoes, heat stress has a profound effect on seed, root expansion, and pollen availability. Due to vast changes in temperatures, it is important to study heat-tolerant varieties and figure out how they are adapting to survive in certain heat conditions. We study different heat-tolerant tomato varieties by analyzing the gene expression patterns in pistil growth after pollination. A key aspect in studying tomato gene expression is gene annotation, it is a process where we can identify the gene location, plant pathways and coding regions that determine what they do. However, gene annotation has been an issue for many years and remains a difficult challenge in understanding the genomes of biological life. In order to solve this enigma, we have to use accurate and efficient databases that can sort out the data we gather from different tomato varieties. Databases like Agrigo and PANTHER are excellent resources to retrieve valuable information that can discover particular genes and pathways that are active in the tomato varieties. The main asset of these databases is gene ontology as it provides access to understanding the specific annotation, vocabulary, function, and category of the associated genes. With all these resources available to us, we will utilize them in our project to determine which Gene Ontologies and plant pathways are active during acute heat stress.

Title: The Lingering Effects of the Trump Administration and Covid-19 For Refugees and Migrants

Student Author: Cameron Mercer

Faculty Mentor (s): Dr. Tarazona-Sevillano

College: College of Liberal Arts and Sciences

During the Federal Fiscal year 2016, the United States received 89,994 refugees and 1.49 million foreign-born Individuals. My community experience has showed me that refugees and migrants represent more than a statistic or a point of discussion. These groups of people escape war, persecution, genocide and poverty just to name a few of the obstacles faced. Upon arrival to the United States, federal, state, and local support is crucial to their success. This support can include cultural orientation, language training, job referrals, and financial support from both private and public entities. Refugees and immigrants support the local economy, add cultural diversity, and illustrate the possibility of attaining the American Dream. Recently, the Covid-19 pandemic and regulations from the Trump administration have strained resources and added barriers to those wanting to come into the United States. These factors have also caused a decrease in the number of refugees accepted, disruptions in court processing, and less funding to local partners such as the Catholic Charities of Charlotte. This research will help volunteers, local, state, and federal partners understand the present challenges faced by these groups. As a new administration hopes to revive past policies and as the United States hopes to exit a pandemic, acknowledging the present issues can help prevent organizational complications. Ignoring these issues could cause agencies, who help newcomers, to become overwhelmed in the coming fiscal year.

Title: Assessing the Impact of COVID-19 on the Health and Well-Being of Healthcare Professionals in North Carolina, United States

Student Author: Catherine Luba

Faculty Mentor (s): Dr. Monika Sawhney

College: College of Health and Human Services

The Coronavirus Disease of 2019 (COVID-19) disrupted everyone's life, but it arguably affected healthcare professionals the most. The impact of COVID-19 is great, but few studies have been done on healthcare professionals, and even fewer have been done on the gender dynamics in healthcare. The purpose of this study is to find out how substantially it directly affected healthcare professionals in regards to mental health and well-being, with a focus on gender. We will be able to look at North Carolina, U.S., along with the medical sites being private facilities and cross-sectors, which shows a different perspective. This cross-sectional study will focus on demographics (gender, race, job characteristics), burnout, stress, and how COVID-19 as an event affected healthcare professionals. This study will be conducted by distributing a completely anonymous survey (Qualtrics®) through an anonymous link by a blind copy email to 1000 probable participants, which will be sent through the three medical organizations in North Carolina's respective databases. Three analytical instruments are used in the survey: Perceived Stress Scale (PSS), Oldenburg Burnout Inventory (OBI), and the Impact of Events Scale (IES-R), which look at their respective areas of burnout, stress, and COVID-19. Preliminary analysis shows that there is an increase in stress, burnout, PTSD, due to COVID-19. especially in women when comparing gender. The results of this study will address the gender gap and reassess the needs of healthcare providers in the future to create appropriate intervention and coping strategies.

Title: Defining SNX-BAR Protein Lipid Binding Specificity

Student Author: Carrie Rapier

Faculty Mentor (s): Dr. Richard Chi

College: College of Liberal Arts and Sciences

SNX-BAR proteins are a class of sorting nexins that play a role in membrane trafficking. Originally discovered to be key contributors to endosome function, the SNX-BAR proteins are thought to aid in the sorting of packages to their correct destination by using their cargo recognition and membrane remodeling properties. The long-standing assumption in the field is that all SNX-BAR proteins function similarly. However, work from our lab has identified other roles for SNX-BAR proteins, including an emerging number functioning on autophagy-related processes. Understanding the molecular mechanisms of how SNX-BAR proteins regulate autophagy is a major goal of the project. SNX-BAR proteins have been shown to possess two functionally important domains, a Phox homology (PX) which binds to lipids such as Phosphatidylinositol 3-phosphate (PI3P) and a Bin/Amphiphysin/Rvs (BAR) domain that drives dimer formation. Our lab recently characterized a novel SNX-BAR protein, Vps501 that uniquely localizes to the vacuole membrane and has point mutations in the PX domain. We hypothesized Vps501's PX domain has binding activity dependent on membrane lipid composition of the vacuole membrane. To test this, we have successfully expressed Vps501 in bacteria and performed liposome sedimentation assays using other SNX-BAR proteins as a control to determine any lipid specificity.

Title: An Examination on the Impact of Speakers' Explicit Discussion of Strategies on Joint Tasks

Student Author: Chika Ibekwere

Faculty Mentor (s): Dr. Alexia Galati

College: College of Liberal Arts and Sciences

This experiment examines interpersonal alignment through the use of spatial tasks. According to the prominent view by Pickering and Garrod (2004), task partners converge conceptually while monitoring each other's perspectives, which in turn promotes task performance between pairs (better accuracy and efficiency). However, the generalizability of this concept is unknown in other contexts. For instance, it has been suggested that high alignment in complex motor tasks and tasks that involve visual search may be harmful to task performance, as a "division-of-labor" strategy may better favor performance. In pairs, participants were involved in ten trials, five of which were route planning and five were for visual search, with increased difficulty across trials. In route planning, pairs were told to find the fastest route from point A to point B. In visual search, pairs were told to count stations sharing some characteristic on the map given. Conversational turns were transcribed and coded. The coding process involved coding for acceptances (agreements between partners descriptions), metacomments (comments about strategies or the state of the task) and landmarks (references to map locations). For the purpose of the presentation, I focused on metacomments. Due to the nature of the route planning task that requires pairs to adjust to the other's perspective, it is expected that route planning would result in more alignment than visual search. Therefore, I predict that the speakers' use of metacomments will exhibit higher correlation in route planning than visual search. I expect that results will inform how alignment, as well as aspects of disalignment and complementarity, are emerging properties of the interaction that helps serve task goals.

Title: How fast is fast enough? Walking Cadence (steps/min) and Intensity in Children: A Systematic Review

Student Author: Chris McClurkin

Faculty Mentor (s): Dr. Catrine Tudor-Locke

College: College of Health and Human Services

Background: Cadence (steps/min) is associated with walking intensity in adults. Updated evidence to understand the cadence-intensity relationship in children is needed. The metabolic equivalent (MET) level associated with walking at different cadences can be classified as moderate (3 METs) or vigorous (6 METs) intensity.

Purpose: To review literature on how fast is fast enough, in terms of cadence, for public health walking recommendations for children.

Methods: Relevant studies will be compiled using systematic English-language literature searches of MEDLINE (PubMed), CINAHL, Web of Science, and SPORTDiscus databases. The Boolean string that will be used is (walk* OR ambulat*) AND (pedomet* OR acceleromet* OR monitor OR 'wearable technolog*' OR tracker OR counter OR device) AND (cadence OR 'Steps per min*' OR steps/min* OR stride) AND (child* OR adolescen* OR youth). Once relevant articles are found they will be included based off age range, whether the study is observational or longitudinal, and if they relate to cadence and ambulatory behavior.

Results: We hypothesize that, similar to the adult literature, the relationship between cadence and intensity is strong for children but we anticipate there will be less literature than there currently exists for adults.

Conclusion: This literature review will identify gaps and opportunities in terms of associated cadence with intensity in children. This knowledge will lay the foundation to address "how fast is fast enough" for this age range.

Title: Gentrifying Georgia: Examining how Urban Restructuring is Impacting Brookhaven's Immigrant Neighborhoods

Student Author: Claire Patrick Faculty

Mentor (s): Dr. Colleen Hammelman College:

College of Liberal Arts and Sciences

Brookhaven is a diverse suburban city with a rapidly increasing immigrant population in the Atlanta metropolitan statistical area. Situated along the international corridor of Buford Highway, Brookhaven is home to many immigrant-owned businesses. Previous reports have documented increasing rent as new developments move into the neighborhood; however, little is known about the perspectives of immigrants who are experiencing these changes. Whereas other big cities in the United States tend to have singular ethnic enclaves, immigrants in the New South tend to settle in suburban areas like Brookhaven. By looking specifically at Brookhaven, this research intends to contribute knowledge on how urban restructuring is shaping the ways in which immigrant neighborhoods and immigrant-owned businesses are being changed and maintained in the suburbs of the New South. To examine these Brookhaven dynamics we will use a combination of demographic data analysis, neighborhood field surveys, and interviews with leaders of local immigrant-focused community organizations and businesses. We expect to see evidence of gentrification occurring in and around neighborhoods. We also seek to develop a better understanding of how immigrant communities create a sense of place in light of urban restructuring. These findings will help contribute knowledge to the growing body of gentrification literature regarding immigrant experiences and perspectives. Overall, this research will help inform immigrant-focused organizations on ways to engage with immigrant communities and promote social cohesion within neighborhoods. This is part of a larger study that seeks to examine how gentrification and urban change affect migrant foodscapes in Atlanta, Charlotte, and DC.

Title: Integrating an Ultrasonic Anemometer Onboard a Quadrotor Drone for Wind Data Collection

Student Author: Connor Davidson

Faculty Mentor (s): Dr. Artur Wolek

College: College of Engineering

Quadrotor drones have the potential to offer a wide range of services in urban areas such as monitoring local weather conditions, package delivery, and infrastructure monitoring. However, urban environments remain inaccessible to many quadrotors during adverse wind conditions that increase collision risk and compromise performance. This research aims to integrate an ultrasonic anemometer (the TriSonica Mini Anemometer developed by Anemoment LLC), with a custom-designed quadrotor, based on the QAV500 V2 chassis, to provide 3D wind vector measurements in flight. Several mounting brackets were designed in the CAD (computer-aided design) software, SolidWorks, and 3D printed using PLA (polylactic acid, chosen due to high stress-strain properties) filament. Onboard software was developed to allow the drone's onboard computer (NVIDIA Jetson), to receive and log data output from the anemometer for later analysis. Experiments are planned to collect data during static (ground level) and hovering drone flight tests. A MATLAB tool will be developed for graphical inspection of data and comprehensive analysis, including calculation of wind magnitude/direction statistics and power spectral density. The integration of the anemometer with the quadrotor will support ongoing research in the Autonomous Robots and Systems Laboratory (ARSL) at UNC Charlotte that aims to improve quadrotor flight control and path planning in urban environments.

Title: Requirements for Support: Analyzing the Effects of Competition and Legislative Effectiveness on Electoral Success

Student Author: Emma Wakeman

Faculty Mentor (s): Dr. Eric Heberlig

College: College of Liberal Arts and Sciences

To what extent do congressional leaders impact electoral outcomes based on the legislative effectiveness of their peers? Donations from interest groups are necessary in order to run a successful campaign. Studies reveal that access PACs rely on the indicators of legislative effectiveness, such as committee assignments, leadership roles within those assignments, and effective action on the floor, in order to determine their likelihood of providing campaign support. The purpose of this project is to determine to what degree interest groups weigh the same attributes of incumbents differently based on whether the incumbent is in a competitive contest. We expected interest groups to contribute more to incumbents in highly-competitive elections than non-competitive elections, regardless of the incumbent's legislative effectiveness, because quality challengers, especially those from an opposing party, force incumbents to raise more support in order to win re-election. We combined Heberlig and Larson's "House Incumbent Fundraising" dataset and Jacobson's "House Candidates" dataset to study variables from the 1992 to 2014 election cycles. We predicted this panel analysis will show competition having a larger impact on election contributions in the later elections. We also predicted that interest groups will contribute moderately to incumbents that are active in legislative processes, but will consistently give more to incumbents in competitive elections. By comparing these results with the committee assignments of incumbents in a simultaneous election year, this study will provide insight on how majority leaders in the House can influence an incumbent's legislative success and, in turn, their electoral success.

Title: 19th Century Women, Translation and Science - Gendered Abjection in Elizabeth Gaskell's Gothic: Miserable Marriages, Dark Doubles and Fatal Families

Student Author: Erin Dulin

Faculty Mentor (s): Dr. Alan Rauch

College: College of Liberal Arts and Sciences

This work explores gendered abjection through the lens of Julia Kristeva's theories in The Powers of Horror an Essay on Abjection in three of Elizabeth Gaskell's short Gothic stories. These works, published between 1858 and 1861, are "The Grey Woman," "The Poor Clare" and "The Doom of the Griffiths." Each of the short tales display gendered abjection in similar but slightly different modes. For Kristeva, abjection as a general term, refers to a physical response, often revulsion, that occurs when there is loss of distinction between subject and object or between self and other. The proximity of subject and object complicates how "meaning" is discerned by both characters and readers at large. Gendered abjection, more specifically, refers to any form of abjection with a distinctive focus on gender roles and politics. Overall, the feminine is abjected as a result of the harmful relationships between dominant men and subjugated women and the societal expectations placed on women. However, this dynamic is contradicted in complex ways in "The Doom of the Griffiths," where the masculine is repeatedly abjected through changes in the female characters. In "The Poor Clare," the protagonist is abjected through the conflict between her parents and grandmother. In the first story, "The Grey Woman," the heroine is abjected through the abusive relationship with her husband and in her plans to escape from him. The essay also defines the different purposes abjection serve in the story, ranging from protection to punishment. Women are usually placed as the abjected and men as the abjecticators; this remains true even in the one story where this dynamic is reversed.

Title: Expanding Entrepreneurial Thinking Across Campus Through Digital Badging

Student Author: Ethan Hefner

Faculty Mentor (s): Dr. Laura Smailes

College: Ventureprise

Digital badging is a concept that centers on students or employees earning online badges for completing a variety of objectives. Many universities have designed tailored badging programs, ranging from digital design to lab courses, producing strong academic results. Ventureprise, UNC Charlotte's Innovation and Entrepreneurship Center, could prove to be an excellent launching pad for a newly developed badging system as it seeks new ways to enhance entrepreneurial thinking across campus. With no direct student pipeline, Ventureprise seeks a unifying program to drive participation and create a culture of entrepreneurial thinking among students and faculty throughout all eight colleges at UNC Charlotte. Research to date shows that college students have experienced higher grades, achieved higher levels of mastery in courses, and dramatically increased their credentials on their resumes leading to more job opportunities due to the implementation of badging programs. However, research also shows that many professors are hesitant to implement badging for a variety of reasons, most having to do with technology. For this research project, we will examine ways to expand engagement of faculty and students in social impact, entrepreneurship and research commercialization through a cross campus co-curricular badging program. Students and faculty will be interviewed and surveyed on their views and experiences with co-curricular activity. This data will be evaluated in order to construct a digital badging system to be implemented at Ventureprise as well as in undergraduate and graduate courses at UNC Charlotte.

Title: Enhanced Thermal Imaging of Blood Vessels

Student Author: Gunnar Olson

Faculty Mentor (s): Dr. Susan Trammell

College: College of Liberal Arts and Sciences

Enhanced Thermal Imaging (ETI) is an infrared (IR) imaging technique (8-10 microns) that uses heat as a contrast agent to detect vascular structures embedded in tissue. The human body emits strongly in the thermal IR, but different tissues are all at about the same temperature and therefore have the same brightness in a thermal image. Consequently, it is difficult to differentiate between tissue types seen in a standard thermal image. ETI is a new method of thermal imaging that provides the ability to highlight vascular structures in tissue by selectively heating embedded blood vessels. Tissue is illuminated with a green LED (530 nm). Blood absorbs this green light more strongly than water-rich tissue and this causes the blood to heat by ~0.5 °C relative to the surrounding tissue. This selective heating makes the vessels appear brighter in a thermal image. In this work, a Monte Carlo simulation called MCmatlab was used to simulate the absorption and scattering of light incident on a tissue sample containing epidermis, dermis and blood vessels. Simulations were performed with different illumination wavelengths and beam sizes, along with different vessel depths and orientations. Results indicate that 532 nm light provided the best balance between penetration depth and vessel heating. This wavelength deposited energy into the blood vessels to a depth of approximately 0.5cm. These simulations will allow for optimization of the illumination parameters for ETI. Future applications of ETI include the delineation of microvasculature associated with tumor margins and assessing perfusion during reconstructive surgery.

Title: Novel Linear Beam Shaping Methods for Integration into a Laparoscopic Laser Tissue Sealing Device

Student Author: Haleigh Grose

Faculty Mentor (s): Dr. Nathaniel Fried

College: College of Liberal Arts and Sciences

INTRODUCTION: Radiofrequency and ultrasonic devices are currently used for sealing of vascular tissues during laparoscopic surgery. Our laboratory is exploring infrared lasers as an alternative technology. Previously, a 1470-nm laser and device were tested ex vivo and in vivo for sealing vessels, producing faster seals and less collateral thermal damage to adjacent healthy tissues. The purpose of this study is to explore improved methods for creating a uniform linear laser spatial beam profile across the vessel, with integration into standard laparoscopic surgical device jaws.

METHODS: Two designs were explored: a fiber optic bundle and reciprocating single optical fiber. For both designs, fibers were angle-polished at 42° to optimize 90° light delivery. The fiber bundle design contained three stacked multimode side-firing fibers, overlapped to produce a linear beam profile. The reciprocating design utilized a servo motor attached to a single side-firing fiber, scanning laterally to produce a linear beam. Arteries were dissected from porcine kidneys and used for testing both designs, ex vivo.

RESULTS: The fiber bundle and reciprocating fiber needs to achieve consistent sealing of blood vessels. Seals are considered successful if their burst pressures exceed 180 mmHg (normal systolic blood pressure), when they are connected by a needle and tubing to a syringe pump, and water is flowed through the system until the seal breaks open.

CONCLUSIONS: Both side-firing fiber bundle and scanning single fiber methods are expected to produce uniform linear beam profiles and high vessel burst pressures, enabling future integration within a laparoscopic device for pre-clinical testing.

Title: The Text Message Study: How New Age Technology is Effecting the Social and Sexual Aspect of Young Adult Relationships

Student Author: Haley Good

Faculty Mentor (s): Dr. Montanero

College: College of Liberal Arts and Sciences

Young adults engaging in communication via text messages has become increasingly common in today's modern society, and has changed the way young adults discuss dating, flirt, and even talk about sexual health. These changes have led to an overall lack of sexual health discussion and an increase of miscommunication of boundaries in young relationships. Through the use of qualitative data analysis this report seeks to explore how text messages of young couples in the first six months of their relationships in order to examine the ways in which they discuss sexual health and sexuality through text messages.It is important to study these couples through the first six months of dating because it allows us to see the developmental stages of the relationship and helps us to detect when instances of flirting, dating and sexual health conversations begin. Through a review of literature it is reported that more than one in ten (13%) female teens and one in six (17%) male teens had more than four sexual partners in their lives. Even though condoms are a male form of contraception is reported that only 69.6 percent of men initiate the conversation of using them. This study is significant because it discusses the communication of sexual health and education between adolescents. This study creates a discussion which will help to make sexual health a more universal topic of discussion in relationships. The proposed study will review the broader literature to (1) determine how gender may influence the initiation of sexual health discussions?, and (2) which sexuality-related topics are discussed via text messages? This study will further allow researchers to establish what the new sexual norms between young adults are and allow researchers to determine ways to lead more healthy and educated conversations with young adults.

Keywords: Sexual education, Young adults, Sexual health

Title: The Effects of Novel Experiences on the Development of Self-Efficacy and Knowledge of Self

Student Author: Hayley Owen

Faculty Mentor (s): Dr. Erin FitzPatrick

College: College of Education

Research has shown that many people lack confidence in the current path they are taking in their lives. However, participating in new experiences and opportunities can help one realize that they need to be on a different path, or reaffirm the choices they have made. At UNC Charlotte, the Road to Reading tutoring program has provided undergraduate preservice teachers with the opportunity to gain valuable teaching experience. This program trains undergraduate students as reading tutors to provide interventions for first grade students with reading difficulties and allows the undergraduates to practice teaching skills. The purpose of this study is to examine the extent to which experiences can help individuals achieve a deeper understanding of themselves and their goals in life. The undergraduate students were interviewed about their experiences and how those experiences affected different aspects of their lives and education. Those interviews are now being coded to identify themes of self-efficacy, confidence, and others that could be examined to determine the effects of the program. We expect to find that participating in new experiences and developing new skills can help individuals grow in confidence and self-efficacy, as well as provide individuals with a deeper knowledge of self.

Title: A Case Study of a Serial Murderer: The Green River Killer: Gary Ridgway

Student Author: Heather Perrine

Faculty Mentor (s): Dr. Charisse T.M. Coston

College: College of Liberal Arts and Sciences

This research study focuses on the application of serial killer research to the case of the Gary Ridgway. In so doing, the nature and scope of serial murder, and similarities and differences in the case of Gary Ridgeway compared to literature will be explored. Interventions that could have been made are suggested.

Title: Racial Equity in Seminars and Curriculum: Teacher Interviews Six-Months After Professional Development Seminars

Student Author: Jaden Schutt

Faculty Mentor (s): Dr. Scott Gartlan

College: College of Liberal Arts and Sciences

Research suggests that PK-12 curriculum focused on racial equity and social justice themes are important to attaining greater achievement by students. This study examined four public school teachers who participated in professional development seminars led by university professors, including a written curriculum project based on racial equity research and existing PK-12 classroom standards. Teachers were interviewed six months after the professional development seminars. Interviews were recorded over Zoom and transcribed for analysis. Grounded theory methodology and constant comparison method were used to identify codes, categories, and themes first individually, then among all four interviews to identify common themes. Additionally, each teacher's 20-page curriculum unit was examined to explore the relationship between written curriculum and lived experiences. An interview with a mixed-race female 3rd grade teacher yielded 143 codes through open coding, then through constant comparative analysis 15 categories were formed through associating codes. Finally, themes among the categories emerged: Student Impact, Intellectually "Molding and Stretching" Learning Experience, Curriculum Implementation Challenges, and Confidence Gain in Teaching Racial Equity Topics. Preliminary curriculum unit analysis indicated themes for 3rd grade teachers and students around equity, access, modification, anti-racist pedadogy, and urban renewal. Additional interviews and curriculum will be included on the final research poster. Recommendations for teacher professional development settings include ways to engage diverse students with relevant content, provide intellectual rigor for teachers, and evaluate assumptions about curriculum. Future research should explore how seminars on racial equity topics influence elements of effective teacher professional development, such as collaboration, content focus, and mentoring.

Keywords: racial equity, PK-12 teachers, professional development, confidence, interviews, curriculum

Title: Predicting Flood Damage for Emergency Decision Support using Data Analytics

Student Author: Jannat Ejaz

Faculty Mentor (s): Dr. Nicole Barclay and Dr. Michael Smith

College: College of Engineering

Floods are considered to be one of the most common yet deadly natural disasters that have claimed hundreds of lives throughout the world while causing mass destruction. The causes of these floods are due to long periods of heavy rainfall, high tides (in coastal areas), and human activities that may cause blockage in drains. We have increasingly seen over the past several years that the population is rapidly growing which increases urbanization and impervious areas, causing problems such as less infiltration of rainfall, resulting in an increase in runoff. Climate change has also exacerbated flooding problems. This research aims to identify variables that are affecting creeks in Mecklenburg County to produce a data-driven model (i.e machine learning), that will help identify areas that are at risk of flooding. We examine the creeks in Mecklenburg County to understand the factors that are affecting the creeks and why some are frequently flooding, while others are not. We aim to understand the relationship between discharge, rainfall, and gage height with the help of different models such as regression and classification which will allow us to identify how the variables impact the creek and the flooding around them. We determined impervious covers in Mecklenburg County and grouped them into three categories; residential, commercial, and edges and pavements. We calculated the percentage of each of the covers in our study location and compared them across each creek's watershed area using ArcGIS.The results of this research will help to make disaster management quicker and efficient.

Title: Alternative Conceptualizations of Organizational Performance: Making the Case for Non-financial Measures

Student Author: Jett Naisang

Faculty Mentor (s): Dr. Victor Zitian Chen

College: Belk College of Business

Purpose: Through our research, we aim to understand how organizations can measure performance using customer "well-being" constructs. While existing norms rely on financial measures of organizational performance, we believe that the ability to generate value for various stakeholder groups (e.g., customers) is a critical component in assessing performance. Thus, our research compares different perspectives and beliefs surrounding the value organizations provide to customers in order to establish how customer well-being can be defined and measured.

Approach/research: We conduct a systematic review of empirical articles in top strategy and consumer behavior journals to identify key customer-centric constructs related to performance (e.g., customer satisfaction) within the existing literature. We then classify these constructs into a broader taxonomy and consider the consistencies and inconsistencies across measurement techniques within the larger framework.

Findings: In this research we have found evidence suggesting that organizations contribute to customer well-being in many ways, supporting our claim for non-financial measures of organizational performance. Some examples include an organization's ability to foster customer trust (CITE), to provide a medium for social interaction (CITE), and to generate feelings of identification between the organization and the customer (CITE), among others. Our review suggests that these are critical starting points for establishing definitions of customer well-being, laying a foundation for non-financial measures of organizational performance.

Title: Mercury Thione Complexes as Probes to Develop Potential Silver Anticancer Drugs

Student Author: Joanne Azar

Faculty Mentor (s): Dr. Daniel Rabinovich

College: College of Liberal Arts and Sciences

For many years, metals have played important roles in biological systems, both harmful and helpful. One of the most useful ways that transition metals can be used is via coordination chemistry. For example, coordination complexes of silver and palladium have been used to treat adenocarcinomas. The issue with current cancer treatments targeting adenocarcinomas includes increased tumor resistance, harmful side effects, and high cost. Our research focuses on synthesizing and testing the biological activity of new, inexpensive N-heterocyclic thione and selone compounds coordinated with silver ions. This approach brings a revolutionary pharmaceutical therapy into cancer treatments and demonstrates the role of transition metals in biological systems. To properly understand the structures of these complexes and how they may behave in biological systems, other metals, such as Hg^{2+}, can be used as probes. Previous research has shown that transition metals coordinated with NHT and NHSe ligands are useful against prostate cancer cell lines. For this research project, we will be synthesizing N-heterocyclic thione ligands with bulky substituents, particularly 2,6-diisopropylphenyl, to produce mercury chloride, bromide, and iodide derivatives. Complexes isolated in pure form, as determined by elemental analysis and other techniques, can then be used for testing biological activity on prostate and hepatic cancer cell lines to understand the mechanism of action of Ag^+ and related metals in the body.

Title: Cell Specific Targeting Via RNA Aptamers

Student Author: Jonathan Black

Faculty Mentor (s): Dr. Kirill Afonin

College: College of Liberal Arts and Sciences

Nucleic Acid Nanoparticles (NANPs) are highly programmable scaffolds that have been demonstrated for broad applications such as biosensors and therapeutics. Herein, we investigate three unique RNA aptamers (TN2, TN20, TN145) identified using Systematic Evolution of Ligands by Exponential Enrichment (SELEX) to target triple-negative breast cancer cells (TNBC) specifically. Using these aptamers paired with various functionalized RNA nanoring orientations, we will test the uptake and successful targeting of the TNBC cell line. The Nanoring structure allows for controlled self-assembly, reproducible structure, and predictable function. By targeting mRNA using the RNAi cellular pathway, we can induce the silencing of specific genes in the cell (Green Fluorescent Protein (GFP)). Cellular uptake, specific targeting, and maintained silencing efficacy are three critical functions of our Nanoparticle-Aptamer complex that will be studied and characterized, adding increased customizability and specificity to our library of Nucleic Acid Nanoparticles. Showing the successful and repeatable assembly and maintained function of our Nanoring-Aptamer complex allows us to explore a wide range of aptamers specific to many different targets of interest.

Title: Internal Short Circuit behaviors of Lithium-ion Batteries upon Dynamic Mechanical Loading

Student Author: John Sherman

Faculty Mentor (s): Dr. Jun Xu

College: College of Engineering

Lithium-ion batteries (LIBs) have been an increasingly popular choice as power sources for electric vehicles. However, inevitable vehicle crash/impact scenarios pose great threats to the mechanical integrity of LIBs. Previous research has endeavored pioneering and tremendous efforts in the triggering of internal short circuits (ISC) and their behaviors upon quasi-static mechanical abusive loading but seldom touched the dynamic loading cases where possible strain rate and structural inertia effects may come to play a dominant role. To this end, we propose to conduct operando and post-mortem testing and characterization for LIBs upon dynamic loading to discover the ISC behaviors of the cells. Additionally, a mechanics-electrochemistry coupled model is established with the consideration of the mechanical failure of component materials to unravel the fundamental mechanism of the ISC behaviors. Results provide important insights for the ISC triggering process due to the external mechanical-loading-induced stress and offer battery safety design guidelines.

Title: The Impact of Academically and Intellectually Gifted (AIG) Plans on Leaners from Diverse Groups

Student Author: Josie Peplinski

Faculty Mentor (s): Dr. Cindy Gilson

College: College of Education

Students from diverse backgrounds including non-White students, English Language Learners, and Twice Exceptional students are less likely to be identified for Academically or Intellectually Gifted (AIG) services. All AIG students require differentiation, including learners from diverse groups, and an effective AIG district plan will outline specific practices their schools can use to ensure inclusive gifted programming. The most common practices include AIG staff collaboration with English Language Learner teachers and general education teachers, as well as providing professional development opportunities surrounding culturally relevant teaching. Using Individualized Education Programs (IEP) to plan for readiness differentiation and recommend advanced courses or pathways is another popular strategy. By analyzing the specific differentiation strategies outlined in the AIG plans, the current study aims to determine whether the practices outlined in the AIG plan lead to equitable representation of underrepresented gifted learners. This study will use a combination of qualitative content analysis of Academically and Intellectually Gifted Plans as well as regressions and correlations using demographic information from North Carolina's Department of Public Instruction. When considering the 2019-2022 Academically and Intellectually Gifted Plans from North Carolina's Southwest District 6, I hypothesize a positive correlation between the number of sentences mentioning responsiveness to diversity in each plan and the percentage of non-White students enrolled in that district's gifted programming.

Title: I Don't Want to Spend This Much Time on PubMed. How About You? Data Mining PubMed Publications for Genome Information

Student Author: Josephine Leugers

Faculty Mentor (s): Dr. Robert Reid

College: College of Computing and Informatics

There are 32 million links to free online medical research papers on a public access database called PubMed. A large subset of these publications contain useful genomic data that can provide insight into human health. Unfortunately, the massive number of papers and the fact that the data is contained in millions of html tables makes actually finding and using the data inconvenient and time-consuming. The purpose of this big data project is to collect published papers related to genomic research, read the tables of genomic data in them, and cluster the data with the goal of associating related papers and finding statistically significant connections among the clusters. Finding these links is valuable because these connections could provide insight between the diseases that the papers studied and genetic and genomic features.

122,000 relevant PubMed reference papers were downloaded from the internet and stored in the UNCC research computing cluster. My contribution to the project involves writing programs that scrape these papers to find data stored in html tables and finds and separates all the files that contain genetic string identifiers. Tables are saved in the standard data filetype for Microsoft Excel so that the contents of the files can be investigated using any common statistical software. Completed analysis of the tables might uncover a previously unknown relationship between diseases without conducting expensive new medical research.

Title: Advanced Measurement Techniques for 3D Metal Printing (Laser Powder Bed Fusion)

Student Author: Jose Maldonado

Faculty Mentor (s): Dr. Konstantinos Falaggis

College: College of Engineering

Complex metal parts produced by additive manufacturing processes are often very difficult to be measured using non-contact measurement systems. The most efficient and effective approach to measuring metal additively produced parts, particularly those produced in a laser powder bed fusion process, is to measure each layer of the part as it is sintered. In this layer-wise measurement approach, it is possible to detect defects in the final part while the part build is still in process. In this research, we investigate Structure from Motion techniques as a viable 3D measurement technique in terms of accuracy. This research project used existing structure from motion code in Matlab to process pictures of the structure and created a 3D model of said structure. The code was optimized for accurate modeling and to reduce measurement errors on the 3D model. For this method a camera was used to take multiple pictures from different angles. These pictures were then uploaded to the optimized program in Matlab to recreate the 3D model. The 3D model was then measured to calculate the accuracy and any scaling errors of the structure from motion program. The accuracy of the 3D model created was used to determine if structure from motion can be used as a non-contact measuring system.

Title: Neocolonial Englishes: A Case Study of Marshallese Children's Speech

Student Author: Kara Richardson

Faculty Mentor (s): Dr. Elise Berman

College: College of Liberal Arts and Sciences

Previous research has found that Marshallese living in both the Republic of the Marshall Islands, a small island nation in Oceania, and the U.S.A. speak a variety or dialect of English that has been called Marshallese English (ME). Two accounts of these two populations have documented some overlapping, and some distinct features. The focus of this applied research project is to see if any of the features currently only documented as spoken by children who live in the U.S.A. are also found in the Marshall Islands.

To compare the ME spoken by children who have grown up in the U.S.A. to children in the RMI, we use Berman's data from research in the U.S.A. and the video files from a documentary, The Last Generation, that features three Marshallese children who live in the RMI. We used MAXQDA transcription software and documented intonation units, syntax, and some phonology. We then analyzed the transcripts for the morphosyntactic features previously identified in Berman et al.'s data.

Preliminary findings suggest that the distinct features documented in the U.S.A. are not, in fact, distinct but rather are shared across communities in both the U.S.A. and RMI.

Title: De-stigmatizing effects of Faith Based Organizations in the End the HIV Epidemic: A Systematic Review

Student Author: Katherine Bolt

Faculty Mentor (s): Dr. Judy

Cornelius

College: College of Health and Human Services

Introduction: HIV disproportionately affects minorities living in the southern region of the United States. Faith-based organizations located in the southern region of the United States have participated in HIV prevention initiatives however, HIV related stigma still exists. In order to reduce HIV-related stigma we must first examine the literature on the effectiveness of faith-based organizations in reducing stigma in minority communities.

Purpose: The purpose of this systematic review is to examine the de-stigmatizing effects of faith-based initiatives with ending the HIV epidemic in African-American and Latinx communities.

Methods: A literature search was conducted using CINAHL, Web of Science, PSY Info, Sociological Abstract, and PubMed databases. The key words for this search included stigma, faith based, HIV prevention, African-American, and Latinx. The inclusion criteria were articles published in English, less than 11 years old and included HIV stigma reducing interventions for African Americans and Latinxs.

Results: The systematic review included 185 abstracts. Of these abstracts 70 were excluded because there was no inclusion of HIV faith-based and stigma initiatives (n=4), were older than ten years (n=10), focused on mental health (n = 24), and not in English (n=1). To date, a total of 76 full text articles are being reviewed along with the gray literature. We will conduct an ancestry search of the selected articles to identify additional references.

Conclusion: The findings from this review will add to the body of literature and our efforts to develop a faith-based HIV prevention initiative that will reduce HIV-related stigma in minority communities.

Title: Using Asymmetric Thiazolothiazoles to Create Solar Photovoltaic Cells

Student Author: Kattherine Garcia

Faculty Mentor (s): Dr. Walter

College: College of Liberal Arts and Sciences

This research is about using organic compounds in order to make photovoltaic cells which can produce energy. The electrons of organic compounds take in light that is emitted from the sun, then this moves electrons to the lowest unoccupied molecular orbital (LUMO). When these electrons are in this high energy state, there is a lot of potential energy which can be capture when a circuit is made. As the electron that has moved up to a higher energy attempts to move back to the lower energy level, there is a current that is made as it moves through the circuit therefore producing usable energy. There are many organic compounds that can participate in these types of reactions. The difficulty is in finding the most efficient compounds that produce the most energy from what they absorb. This research focuses on one set of newly synthesized organic compounds which have the potential to be a part of an efficient photovoltaic cell. These organic compounds do not cause any environmental harm and the goal is to eventually be able to replace all harmful forms of energy. Organic compounds are used in other technologies, such as OLED displays. Although it is currently not as efficient as the forms solar power which are popular today, there is a lot of potential in this research area. It can potentially be the future solution that we have been searching for to reduce harming the environment further and make a big step forward in improving the Earth's health.

Title: Synthesis and Doping of Si(pincer)2 Complexes for Application in Organic Light Emitting Diodes

Student Author: Katherine Norman

Faculty Mentor (s): Dr. Thomas A. Schmedake

College: College of Liberal Arts and Sciences

Organic Light Emitting Diodes (OLEDs) contain an organic electron transport layer which transports electrons from the electrode to the active electroluminescent region. With a growing need for faster, cheaper, and more efficient electronic devices, the exploration of compounds used in this layer is essential. Recently, the Schmedake research group has identified hexacoordinate silicon complexes, which have a central silicon surrounded by two pincer ligands, as being optimal for such devices. Hexacoordinate silicon complexes exhibit a low dipole moment, chemical stability, redox reversibility, water resistance, and luminescence properties. Moreover, the pincer ligands incorporated can be easily customized to change the characteristics of the electroluminescent layer. 2,6-Di-1H-imidazol-2-yl-pyridine (IPI) has a lower unoccupied molecular orbital and is much lighter than most compatible pincer ligands, making it a suitable target for potential use in OLEDs and solar cells. The goals of this research were to (1) incorporate the IPI ligands into hexacoordinate silicon complexes, (2) characterize the Si(IPI)2 complex, (3) create doped films of the product by introducing impurities to improved the electronic properties of the product, and (4) measure the electron mobility of the complexes with and without the doping process. Techniques such as cyclic voltammetry were used to analyze the reduction potential of the molecules. Additionally, ultraviolet-visible and fluorescence spectroscopy were used to analyze optical properties, and x-ray crystallography provided a crystal structure of the compound.

Title: Interrelationship of Art and Architectural History

Student Author: Katherine Tyson

Faculty Mentor (s): Dr. Emily Makas

College: College of Art and Architecture

Architecture and art have always shared a deep connection; however, a rift exists between the two disciplines with overlapping methods. In many cases, one will find that universities categorize these two fields together, but separately. For the past few centuries, art history has been the history of image, but because architecture is subjective to an individual's perspective, it is at odds with the pictorial orientations of art history. Architecture has been developed by art for centuries, but architecture is the only type of art that requires a specific function. This study looks at the relationship of architecture in art history and that it is an extension to its examination. I started by researching how the two disciplines intertwine with each other in everyday life. From there, I began to evaluate how each field applied their analysis skills then were compared through their methods. Historians have no clear consensus of whether or not architecture is adjunct to art. Art and architecture are united through the design, the designer, and the individual meanings behind the work; they use the same organizing principles, visual elements, and engagement of the senses. The findings suggest that architecture is a field within the study of art, but remains distinguished as its own type of design, because of its high control over the daily lives and movements of all people. This is because multiple forces act on art and architecture in the same way they act on other aspects of life, such as philosophy and society.

Title: Evaluating the Correlation between US Policies Changes and Non-Profit Resettlement Agencies

Student Author: Katherine Watts

Faculty Mentor (s): Dr. Gabriela Tarazona-Sevillano

College: College of Liberal Arts and Sciences

Refugees worldwide are forced to flee their countries for the sake of their survival in many cases. As conditions overseas become harsher, more refugees flee to safe haven countries. Receiving countries, as the US for example, implemented extreme and strict policies due to political conditions to prevent immigration. Anti-refugee policies deconstructed refugee arrival programs causing a resettlement standstill that left resettlement agencies like Catholic Charities Diocese of Charlotte (CCDOC) questioning their long-term survival. The US central government policies changes undercut resources that triggered CCDOC's youth programs to rely on public-private sponsors and community-based funding to ensure routine services stay consistent. My research investigates how US policy changes involved major budget cuts that trickled down into CCDOC's youth program. The loss of federal funding disrupts educational services that provide refugee students freedom to equal opportunity and health within American culture. The purpose of this research emphasizes how CCDOC's youth program educates refugee children how to be self-sufficient, while setting them up for future success by introducing how opportunities are stemmed from developing communication skills, seeking summer and future employment, and pursuing higher education. A random sample was taken from CCDOC's summer camp students who come from war-zone countries. Preliminary findings show halting refugee arrivals causes non-profit resettlement agencies to rely on resources from public-private and community-based sponsors, which affects the quality and delivery of educational services to youth clients. Ultimately, recognizing the disproportionate realities refugee children face while highlighting harsher realities regarding learning new ways of life in unfamiliar environments presents numerous challenges.

Title: Economic Development, Climate Change and the Built Environment in the British and Spanish-Speaking Caribbean since the Second World War: A Systematic Literature Review

Student Author: Kartik Sharma

Faculty Mentor (s): Dr. Frances Hsu

College: College of Art and Architecture

The 2021 OUR Summer Research Project entitled "Economic Development, Climate Change and the Built Environment in the British and Spanish-Speaking Caribbean since the Second World War: A Systematic Literature Review '' aims to identify and analyze academic scholarship on the development of the Caribbean as a globalized region in the twenty-first century. The research investigates four sub topics relevant to the formation of the region: 1) Natural Resource Extraction: Oil; 2) Natural Resource Extraction: Mineral; 3) Financial Geographies; and 4) Human Capital.

The topic of mineral extraction in the Caribbean is driven by the mining of aluminum, gold, silver, nickel, limestone, and other valuable material resources in Jamaica, the Bahamas, Cuba, and the Dominican Republic. Bauxite mines in Jamaica, silver and gold mines in the Dominican Republic, and nickel mines in Cuba have marginally benefited the limited area around those mines. Companies such as the Jamaica Bauxite Company and the U.S. Steel's Bahama Cement Company hold an oligopoly on their respective minerals in their respective countries, further supporting the belief that the rich get richer and the poor get poorer. The topic of financial geographies covers real estate and financial globalization in the Caribbean and how it evolved with rapid industrialization. Authors have examined how the economies of Barbados, Cuba, and the Bahamas have shifted in the last 7 to 8 decades from predominantly locally-based agricultural use to increased foreign investment in tourism-related infrastructure.

Title: Phil Freelon's Use of Environmental Strategies to Promote Design Concepts Student

Author: Kelly Byas

Faculty Mentor (s): Dr. Emily Makas

College: College of Art and Architecture

Phil Freelon's work centers around central themes of design integrity and environmental compliance; moreover, he often combines these themes to expand the design metaphors found in his buildings. Particular instances of Freelon's aim to mesh architecture and environmental ethics include: the Harvey B. Gantt Center (Charlotte, NC), Tenley-Friendship Neighborhood Library (Washington, DC), National Museum of African American History & Culture (Washington, DC), and New Castle Public Library (New Castle, Delaware). Each building implements a connection between the overarching parti and energy efficiency through the facade's relationship to the internal program. By conducting comparative visual analysis of the buildings, concepts and motifs emerge that highlight Freelon's design tactics. Utilizing computer software that targets site conditions will more accurately convey the effectiveness of Freelon's designs. Comparing and contrasting this analysis will begin to develop patterns to understand the correlation between an architectural metaphor and design with respect to the environment. Architecture that embraces the environment and conveys a strong artistic or cultural influence creates a multifaceted design and remains the precedent for contemporary development.

Title: Virtual Peer Simulation (VPSim)

Student Author: Keshawn Mathews

Faculty Mentor (s): Dr. Ticola Ross

College: College of Health and Human Services

COVID-19 has affected everyone differently and people have had to adapt. Within the UNC Charlotte School of Social Work, changes and restrictions were imposed on field placements during the pandemic. To support and develop students' social work skills, Virtual Peer Simulation (VPSim) was implemented between UNC Charlotte Field Office and a partnering university. At the graduate level, students were put in groups of four and simulated fictional situations as a client and a social worker for field hours. At the undergraduate level, students worked in groups of dyads and triads and simulated fictional situations as both the client and the social worker. The primary focus for the students during the Virtual Peer Simulation was to demonstrate the use of clinical and generalist skills across all nine Educational Policy and Accreditation (EPAS) competencies and four dimensions. Qualitative analysis is underway using the information gathered from the students who participated in the Virtual Peer Simulation. The student researcher will analyze results by transcribing the student responses, creating codes from the responses, and searching through literature review articles. This research will contribute to the knowledge on Virtual Peer Simulation in social work and similar fields.

Title: Benzodiazepine-Derived Thione and Selone Complexes of Palladium

Student Author: Kristen Minehart

Faculty Mentor (s): Dr. Daniel Rabinovich

College: College of Liberal Arts and Sciences

Cancer is the second leading cause of death in the United States. The incidence rate of cancer is on the rise; therefore, the need for more effective cancer treatments is pronounced. Platinum complexes are among the most studied metal complexes in this regard; due to their effectiveness as chemotherapeutic agents in inducing tumor cell death. Cisplatin, cis-$Pt(NH_3)_2Cl_2$, is a widely used platinum-based antitumor drug used to treat various types of cancer, including bladder, head and neck, lung, ovarian, and testicular cancers. However, severe side effects and drug resistance have restricted the clinical applications of cisplatin. These disadvantages in platinum-based antitumor drugs have led researchers to consider other complexes that can reduce the side effects and improve the effectiveness. Palladium(II) analogs have been given special attention due to their similar structure and coordination chemistry. The purpose of this project is to synthesize and characterize new palladium(II) compounds with the formula $(SBzDzArE)_2PdCl_2$, where SBzDzArE is a family of N-heterocyclic thione and selone ligands derived from a saturated benzodiazepine core. This family of ligands bear a variation of bulky aromatic substituents (Ar = xylyl, mesityl, diisopropylphenyl) and contain either sulfur or selenium (E = S, Se) as the donor group. Characterization of these new complexes involves the use of elemental analysis, nuclear magnetic resonance (NMR) spectroscopy, and other analytical and spectroscopic techniques to assess the composition and purity of these complexes, as outlined in the presentation.

Title: Analyzing the Influence of Genetic Predispositions on Lung Cancer Development

Student Author: Kyleigh Payne

Faculty Mentor (s): Dr. Shan Yan

College: College of Liberal Arts and Sciences

Lung Cancer is the number one cause of cancer related mortality in the United States. Lung cancer is the rapid proliferation of cancer cells within the lungs. This type of cancer can metastasis from and into other regions of the body. The symptoms of lung cancer include chest pains, a worsening cough, fatigue, shortness of breath, coughing blood, and swollen lymph nodes. Lung cancer is categorized into two groups: small cell lung cancer and non-small cell lung cancer (NSCLC). The category of NSCLC is subdivided into squamous cell carcinoma, adenocarcinoma, and large cell carcinoma. The purpose of this study was to detect the correlation between genetic predispositions and lung cancer. To determine the genetic risk factors influencing the development of lung cancer, previous research was gathered from PubMed. These studies were used to collect data and information on genetic, health, social, and gender disparities in lung cancer cases. Specifically, this study takes a deeper look into the genetic risk factors in women with lung cancer who are nonsmokers. Women nonsmokers have a higher rate of developing lung cancer than men nonsmokers. Men and women have differences in genetic risk factors that impact the occurrence of lung cancer and potential efficacy of cancer therapeutics. The predicted outcome of this study is to obtain the associations between women nonsmokers and the genetic risk factors that influence lung cancer formation. This study classifies the genetic predispositions within lung cancer to progress the understanding of causation of occurrences.

Title: Fibrosis, Collagen and Breast Cancer Progression

Student Author: Liz Crenshaw, Courtney Samuel, Katherine Holtzman

Faculty Mentor (s): Dr. Didier Dréau

College: College of Liberal Arts and Sciences

Despite therapeutic progress, breast cancer progression remains a leading cause of death for women. Accumulation of extracellular matrix proteins mainly collagens is an independent clinical parameter of breast cancer progression. While the role of the tumor microenvironment is recognized, the relationship and mechanisms modulating the fibrosis and cancer progression remains to be fully elucidated. Here we investigated the collagen composition on the tumor matrix in tumors collected from a pre-clinical model of aggressive breast cancer. In the 4T1 orthotopic mammary tumor model after 35 days, the effect of the routinely used fluorouracil (5FU) chemotherapy on tumor size and collagen composition was determined. Preliminary data confirmed the therapeutic effects of 5FU in reducing breast tumor size. Interestingly, preliminary observations suggest that fibrous collagen accumulation tended to be correlated with tumor size and that expressions of collagen subtypes and related scaffold proteins were altered. Taken together, these observations confirm the role of extracellular matrix proteins including fibrous collagen subsets and their potential as targets to prevent breast cancer progression.

Title: Stabilization of Protein-Based Biologics using Light-Assisted Drying

Student Author: Maddie Kern

Faculty Mentor (s): Dr. Susan Trammell

College: College of Liberal Arts and Sciences

A variety of biomedical products use proteins to treat or detect diseases. The current standards for processing and storing protein-based biologics include freeze-drying, freezing, and/or refrigeration. Freeze-drying is time-consuming and costly and not all biologics can be stabilized using this method. Freezing and refrigeration are not possible without the proper infrastructure to transport and store biologics. Anhydrous preservation offers a low-cost alternative and can allow for high temperature storage. A novel process known as light-assisted drying (LAD) has proven to be a robust method for dehydrating small amounts of biological samples into amorphous trehalose (sugar) solids using near-infrared light. The noncrystalline trehalose matrix prevents mechanical stress, slowing the biological degradation of the embedded proteins. Thus far, only small volumes (< 50 µl) have been processed using LAD, but standard drug/vaccine doses are much larger (0.1-1 ml). In this work, the ability of LAD to consistently form an amorphous preservation matrix from larger volume solutions is assessed. Samples (250 µl) were dried with a 1064 nm laser in a low humidity chamber for 140 minutes. After LAD processing, the samples showed an average end moisture content (EMC) of 0.204 ± 0.002 gH2O/gDryWeight. This value is consistent with the average EMC of 40 µl samples found previously. Polarized light imaging performed immediately after drying showed little to no crystallization of the protective trehalose matrix. These results indicate that LAD can successfully create a protective structure within larger volume samples and has potential applications in the stabilization of drugs, vaccines, and diagnostic assays.

Title: Assessing the Impact of COVID-19 on the Health and Well-being of Healthcare Professionals in North Carolina, United States

Student Author: Mahita Sadula

Faculty Mentor (s): Dr. Monika Sawhney

College: College of Health and Human Services

The emergence of the Coronavirus Disease 2019 (COVID-19) pandemic has significantly altered social and economic activities, work conditions, and overall everyday life. Currently, there are limited studies that examine how these changes influence the health and well-being of healthcare professionals. Around the world, the COVID-19 crisis continues to overwhelm healthcare systems. Healthcare professionals, especially, are more likely to be in unprecedented situations and are at a higher risk of contracting COVID-19 than the general public. The purpose of this study is to examine the continual effect COVID-19 has on the health and well-being of healthcare professionals by assessing the prevalence of stress, burnout, psychological distress, and other factors experienced among healthcare professionals. A cross-sectional, anonymous survey through an electronic application (Qualtrics®) will be administered to a sample of 1000 participants from three medical organizations in North Carolina. Demographic information and job characteristics will be collected, including occupation, length of working experience, experience in a COVID-19 hospital unit, and total working hours during the COVID-19 pandemic. The self-administered online questionnaire also encompasses the Perceived Stress Scale (PSS), Oldenburg Burnout Inventory (OLBI), and the Impact of Event Scale-Revised (IES-R) to evaluate the perception of stress, burnout, and distress caused by traumatic events, respectively. The preliminary results show that healthcare professionals experienced higher levels of burnout, stress, and other negative effects on their mental health and well-being since the start of the COVID-19 pandemic. This study will help to address and reassess coping and supporting needs of healthcare workers during future outbreaks.

Title: A Study of Image Processing of Video Sequences via SVD and FFT

Student Author: Mai Nguyen

Faculty Mentor (s): Dr. Xingjie Helen Li

College: College of Liberal Arts and Sciences

Singular Value Decomposition (SVD) and Fast Fourier Transformation (FFT) are well-known for image processing, though, each of them has different aspects. We make use of the advantage of FFT in convolution neural networks to automatically find a compatible convolution window size for the process of compressing static images. Meanwhile, we employ the SVD to track the dynamic motions in live video streaming images. A combination of SVD and time series processing is employed to detect the movement of objects and light intensity. By using SVD background subtraction and preforming a study of different rank-k truncation in SVD, we can distinguish the movements and light intensity at various time-moments in video sequences. More future work is expected to perform complex motion detection in video imaging sequence by a combination of SVD, FFT and statistical time-series analysis.

Title: Cross Country Running : A Predictive Analysis

Student Author: Manav Majumdar

Faculty Mentor (s): Dr. Dr. Doug Hague

College: College of Data Sciences

High school cross-country running is a team sport that hosts 5k distance events on a multitude of courses. Research shows that 5k times for athletes improve over a season with training while variables such as lower temperature and difficulty of the course impact the performance of athletes. Our goal is to reduce the uncertainty in the predictive forecast of high schoolers in the upcoming season. We will adopt a multivariate model approach to predict performance within individualized cross-country running times. Environmental and individual performance variables will be included in the model to predict athlete performance and progression through a season. The utilized dataset includes performance and individual data from nc.milesplit.com, environmental information from NOAA, and other sources. Moreover, initial descriptive analysis shows that an individual's performance depends on skill, temperature, and course. This work will develop methods to combine these factors into a predictive model for individual performance throughout a season at specific events, different courses, and variable stipulations.

Title: Food Insecurity Among Senior Residents During the COVID-19 Pandemic

Student Author: Mariam Jaliawala

Faculty Mentor (s): Dr. Nicole Peterson

College: College of Liberal Arts and Sciences

According to research, food insecurity has been linked to health problems. Every country has marginalized populations, and their food insecurity is aggravated by man-made and natural disasters. The number of people affected is unpredictable. The Charlotte-Mecklenburg Food Policy is working to understand how food security for senior citizens has been affected by the pandemic. The purpose of this research is to understand the root problem of food insecurity, the perspectives of the senior citizens, the toll the pandemic has had on this population and the ways they are trying to overcome these obstacles. The method we will use is interviewing household heads and asking questions, such as "Do you think it was difficult for you to get consistent food in 2019 prior to the pandemic? What has changed in the past year with the pandemic?" This will gain a better understanding of the communities around Charlotte and an insight into their eating habits, access to healthcare, housing and transportation. This research will enhance the health of Charlotte's senior citizens, strengthen the local economies and market opportunities, and reduce hunger and food insecurity.

Title: Economic Development, Climate Change and the Built Environment in the British and Spanish-Speaking Caribbean since the Second World War: A Systematic Literature Review

Student Author: Mary Messina

Faculty Mentor (s): Dr. Frances Hsu

College: College of Art and Architecture

The 2021 OUR Summer Research Project entitled "Economic Development, Climate Change and the Built Environment in the British and Spanish-Speaking Caribbean since the Second World War: A Systematic Literature Review'' aims to identify and analyze academic scholarship on the development of the Caribbean as a globalized region in the twenty-first century. The research investigates four subtopics relevant to the formation of the region: 1) Natural Resource Extraction: Oil; 2) Natural Resource Extraction: Mineral; 3) Financial Geographies; and 4) Human Capital. Topic 1) Natural Resource Extraction: Oil involves the analysis of Trinidad and Tobago as the largest oil exporter in the Caribbean. The investigation has focused on the failure of that country's non-petroleum economic sector as well as its extensive entanglements with offshore oil drilling. Topic 4) Human Capital covers subtopics such as internal and external migration, education, and healthcare in order to accurately describe the story of skilled labor and diaspora cultures over the past seven decades. Thus far, findings have described the wide-reaching negative impact of migration on economic growth and rural-urban development in addition to failed strategies in effective, equitably accessible secondary and tertiary schooling and the humane treatment of patients in hospitals and other healthcare facilities in Jamaica, Trinidad and Tobago, and Barbados. This systematic literature review of oil extraction and human capital in the Caribbean has exposed the shortcomings and negative influences on development in the region and provides a foundation for future research and analysis.

Title: Using Schlieren Imaging to Determine Mach Wave Formations at Hypersonic Speed on a Geometric Body.

Student Author: McKenna Goss

Faculty Mentor (s): Dr. Jerry Dahlberg

College: College of Engineering

In this research, we develop a Schlieren imaging technique to image a geometric body of our choosing at hypersonic velocities at 1,000 frames per second. We then describe the findings of these experiments including Mach Wave formation and stability. Discussions are provided with the limitations of the system and various developments used to acquire these images.

Also described are the wind tunnel development including a major repair needed from a

serious failure which blew the top off the test chamber prior to starting this testing. The reconstruction included the reanalysis of many design features to prioritize safety.

Title: Detection and Monitoring of Bacterial Colonization of the Sea Anemone

Student Author: Mora Alabi

Faculty Mentor (s): Dr. Adam Reitzel

College: College of Liberal Arts and Sciences

Animals associate with diverse species of bacteria and these symbioses are important for development, physiology, and health of the host species. As a result of the unique morphology, phylogenetics and tolerance for environmental variation, I am researching the interactions of bacteria with the starlet sea anemone Nematostella vectensis as a model system for studying microbial communities in marine habitats [1]

Recently, a greater focus has been in monitoring and understanding the bacterial community native to the marine habitats and how they affect colonization and the development of N. vectensis In my study, I am utilizing E. coli that contain different fluorescent proteins (pMRE14X) [2] to quantify animal-bacteria symbiosis through fluorescence microscopy. By doing this, I will be able to track how many fluorescent labeled bacteria are in the sea anemone and through that evaluate how well colonization occurs, what stage of the anemone's development that colonization begins, ends and how the changing environment might affect bacterial colonization.

Title: An Examination of Diversity and Inclusion in Association Boards

Student Author: Myia LeGrande

Faculty Mentor (s): Dr. Jaclyn Piatak

College: College of Liberal Arts and Sciences

Inclusion and diversity are essential pieces in the flow of organizations. Through a diverse workplace, organizations can better align themselves to reflect the diverse demographic makeup of America. This, therefore, aids organizations in becoming better attuned to their target audience's wants and needs as well as their employees. Ethnically diverse and inclusive companies have been shown to be 33% more successful and have better odds of attracting the best talent as 67% of job seekers were recorded to care about diversity and inclusion (Glassdoor, 2014). Research has further shown that when employees feel valued for their unique qualities and have a sense of belonging, they report feeling more team-oriented and innovative (Prime and Salib, 2014). Other researchers have concluded that exclusion is a great cost to organizations in the form of compromised job fulfillment, lower awareness of well-being, decreased work effort, reduced employee voice, and leads to greater intent to leave (Travis and Mor Barak, 2015). Using survey data, collected by Dr. Piatak of the University of North Carolina at Charlotte, compiled from over 500 board members from 501(c)(3) and 501(c)(6) associations in the U.S with operating budgets of over $2 million, this presentation serves to examine if feelings of exclusion by board members correspond to a lack of diversity management. Regression models examine if associations with more diversity management practices are more inclusive. Findings have implications for research and practice to advance diversity, equity, and inclusion on boards and in associations.

Title: Understanding the Role of HOXC6 in Survival and Proliferation

Student Author: Nedhe Jariwala

Faculty Mentor (s): Dr. Christine Richardson

College: College of Liberal Arts and Sciences

Ovarian cancer is the leading cause of death among gynecologic cancers in the US. More than 60% of epithelial ovarian cancers (EOC) are not diagnosed until the cancer has metastasized. Understanding EOC biomarkers can increase early detection and survival. Homeobox (HOX) genes are transcription factors that regulate embryonic development and adult progenitor cells. Serous ovarian cancer, a subtype of EOC, exhibits down-regulation of most HOXC genes. The purpose of this study is to determine the role of HOXC6 in survival and proliferation of epithelial ovarian cells. In one approach we will determine if the loss of HOXC6 promotes a transformation phenotype. CRISPR Cas-9 technology will be used to knockdown HOXC6 in normal ovarian epithelial cells. We used the MIT site to identify a HOXC6 guide RNA, inserted the sequence into the PX### plasmid within the larger guide RNA sequence. PX### also contains the Cas9 gene and a green fluorescent protein (GFP) gene for screening. Following transfection, GFP+ fluorescent cells are FACS-sorted and clones analyzed by Western blotting. We will compare wildtype and knockdown cells for proliferation (CellTiter-Glo2.0) and apoptosis (CellToxGreen). In an opposite approach, we will determine if reintroduction of HOXC6 in serous ovarian cancer cells will suppress a transformation phenotype. Following transfection clones will be analyzed by Western blotting. We will compare cancer cells and HOXC6-expresing cells for proliferation (CellTiter-Glo 2.0) and apoptosis (CellTox Green). Overall, we hypothesize that cells with reduced HOXC6 expression will show hyperproliferation analogous to what is observed in patient samples.

Title: Reporting of consent violations among kink practitioners

Student Author: Neha Kissler

Faculty Mentor (s): Dr. Jessamyn Bowling

College: College of Health and Human Services

Kink practitioners face stigma and marginalization. They also experience negative health and social outcomes due to consent violations, which is broader than sexual assault and includes kink behaviors (e.g. spanking). Nearly a third (29%) of kink practitioners have experienced consent violation within a kink context. However, there is little research about disclosing and reporting consent violations from kink practitioners. Therefore, the study aims to further understand experiences related to reporting consent violations within a kink context, outcomes of reporting, and recommended steps regarding reporting. Alt-sex members (including kink, polyamory, swinging, and others; N= 2,996) participated in a cross-sectional survey study with the National Coalition of Sexual Freedom (NCSF), with 767 of them reporting consent violations in kink context. Respondents answered survey questions regarding their experiences with consent violations within kink communities, consequences of reporting to law enforcement and/or event organizers, reasons for not reporting, and recommended changes for society and kink communities. We used inductive thematic analyses for open-ended responses and bivariate statistics for closed-ended responses. Results suggested that the type of consent violation (sexual assault or kink-related behaviors), disclosure, and reporting significantly differed based on gender, sexual orientation, and injury status, but not age. Additionally, dominant subthemes regarding recommended steps included precautions and avoidance of police and other people in positions of power, as well as needing a safe space to report consent violations. The findings of this study have implications for reporting and supporting entities (e.g. law enforcement, kink community leadership).

Title: Movement with a Message: How Dance can be used to Shed Light on Social and Political Issues

Student Author: Nia Mills

Faculty Mentor (s): Tamara Williams

College: College of Art and Architecture

My purpose for this research is to educate others on how dance has and can be used as a source of activism to help bring awareness to different social and political issues. Dance is a tool that can be utilized in a variety of ways. Many believe dance to be a source of fun and entertainment, a possible way to incorporate physical activity into their lives, or even a way to promote physical and emotional healing. As a current dance student, I identify dance as a tool for growth, learning, and expression. Artists have the freedom to create dance works for any desired reason or cause. Through the reviewing of a range of literary sources and video archives, I have chosen to highlight numerous dance figures, dance companies, as well as specific dance works that have attempted to bring about change through movement.

To further embody this research, I began to develop my own dance work surrounding the social topic of modern day slavery. Some examples of modern day slavery include human trafficking and forced labor. With the gathering of research and statistics, I have been able to begin exploring this social issue through dance. The currently untitled two-minute dance excerpt showcases my interpretation of the metaphorical and literal bondage that individuals involved in modern day slavery experience. This presentation discusses my choreographic process as well as goals for further development. It is my belief that using your voice as an artist can be an effective way to inflict change.

Title: "Do our utmost and do it cheerfully": Charlotte Women and Camp Greene during World War I

Student Author: Olivia Dobbs

Faculty Mentor (s): Dr. Heather Perry

College: College of Liberal Arts and Sciences

With the outbreak of the Great War in April 1917, the War Department selected Charlotte, North Carolina two months later to be the site of a large 6,000 acre training facility called Camp Greene. Although it only lasted from September 1917 to June 1919, the camp played a tremendous role in the city's growth and popularity. Recognizing Camp Greene's role in helping the city grow, Charlotte residents, especially the women, welcomed the soldiers and assisted the war effort. The historiography of female mobilization has focused primarily on establishing the context of the movement from a national or state perspective, and little has been done on a city level, leaving questions to be answered about Charlotte women's wartime activities. In this research project, I will read through local newspapers, including the Charlotte Observer and Camp Greene's edition of Trench and Camp, and local archives, looking for articles, files, and government documents that can help identify how women navigated traditional gender norms within their wartime activities. For instance, the Young Women's Christian Association (Y.W.C.A.) hired a female architect, Fay Kellogg, to design and build the Hostess House for Camp Greene, a move that promoted women's participation in a traditionally male-dominated profession. I will also be using the archival research to examine the racial segregation of Camp Greene and Charlotte's women's organizations. In addition to troops and their relatives being racially segregated in the camp, there was also a distinct lack of organizations for black women in Charlotte. Oftentimes these women participated in the war effort by joining predominately white groups, such as the Y.W.C.A., as advisors on how to better reach out to the black community. Overall, through this research, I will illuminate the nuanced roles of women within Charlotte and Camp Greene during the war period.

Title: Variability of Dissolved Organic Carbon within Urban Beaver and Stormwater Ponds

Student Author: Olivia Mikula

Faculty Mentor (s): Dr. Sandra Clinton

College: College of Liberal Arts and Sciences

Dissolved organic carbon (DOC) is measurable organic matter dissolved within water and is the primary component of aquatic food webs. DOC also alters water chemistry by acidification and reactions with trace metals. DOC derives from leaching of plant or soil matter (an allochthonous source) or from aquatic organisms (algae, plants) growing within the water system (an autochthonous source). Specific ultraviolet absorbance (SUVA) is a quantity equal to the amount of ultraviolet absorbance per unit of DOC and is used to determine the source and aromaticity of DOC. High SUVA values indicate DOC from an allochthonous source while low SUVA values indicate DOC from an autochthonous source since carbon derived from leaves and soils is more aromatic than carbon derived from algae. Beaver ponds are surrounded with vegetation that results in leaching of humic substances, while stormwater ponds are dominated by algae that leach simpler carbon substrates. The objective of this project was to use SUVA data to understand the behavior, source, and reactivity of DOC within urban beaver and stormwater pond ecosystems. We hypothesized that beaver ponds will have high allochthonous SUVA values while stormwater ponds will have low autochthonous SUVA values. We can also hypothesize that carbon within stormwater ponds will be more reactive than carbon within beaver ponds because high SUVA values indicate aromatic carbon, which is more stable. These data can aid future decision making for land and stormwater management practices in urban areas as DOC is a key component of water quality.

Title: The Development and Pre-testing of Text Message Reminders to Enhance a Cognitive Based Intervention for African American Heart Failure Patients (TXT COPE HF)

Student Author: Olivia Smith

Faculty Mentor (s): Dr. Charlene Whitaker-Brown

College: College of Health and Human Services

Introduction: African Americans have an increased prevalence rate of heart failure (HF) coupled with depression when compared to other ethnic/racial groups. Symptoms of depression along with anxiety is a predictor of worsening functional capacity and higher mortality rates. Currently, there is no consensus on the best way to treat HF patients with depression and anxiety. Few studies have used cognitive behavior therapy (CBT) and fewer studies have used text messaging to alleviate depression and anxiety with HF patients. To our knowledge, no study has used CBT coupled with text messaging reminders to reduce symptoms of depression and anxiety with minority HF patients.

Purpose: The purpose of this project is to develop text messaging reminders of the Creating Opportunities for Personal Empowerment (COPE) CBT intervention that will be pre-tested with African American HF patients (TXT COPE HF).

Methods: We will use the 8-steps of the ADAPT-ITT model to adapt the seven sessions of COPE for text messaging reminders. The first step in this exploratory feasibility research involves assembling individuals of the targeted population (n= 10) to discuss COPE, the dosage of the text messages and the appropriate time for delivering the text message reminders. We will pre-test the text message reminders consisting of 140-160 characters, GIFs and emojis. The participants will provide feedback with the messages, which will be modified before we conduct a pilot feasibility study.

Results: To date, we have developed 30 text messaging reminders that will be reviewed and pre-tested before we recruit participants for the feasibility study.

Title: An Analog Technique for Determining the Self-Diffusion Coefficient of Introduced Flow

Student Author: Philip T Brown

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

College: College of Engineering

Previous research conducted at UNC Charlotte has shown promising results using a vibrating grain bed as an alternative method to simulate molecular hydrodynamic flow. Unlike other methods, such as light scattering, molecular dynamic simulations, and neutron scattering, this macroscopic analog directly observes molecular flow and particle interactions. As a part of this research, a vibrating grain bed in a steady flow condition was filmed using a high-speed camera; this footage was later fed through PIV (Particle Image Velocimetry) software to created vector fields that were used to determine a structure factor. In a continuation of this research, an attempt is being made to isolate and track the dispersion of grains as they are introduced into flow. In order to accomplish this, approximately 20 grains will be heated for a short period of time; then, the grains will be introduced into a grain bed that is in a steady flow condition using a funnel system. A thermal imaging camera will then be used to create a video that displays the dispersion pattern of the heated grains. Because the thermal imaging camera displays the highest temperature object in its field of view more brightly than all others, it differentiates the heated grains from the cooler grains, acting as a filter to isolate the flow pattern from the introduced grains. This experiment will then be repeated a significant number of times and the videos processed through PIV software. Finally, these PIV measurements will be processed to reveal a centerline that will allow a self-diffusion coefficient to be determined.

Title: Silk Gene Size Across Two Spider Species

Student Author: Priya Patel

Faculty Mentor (s): Dr. Adam Reitzel

College: College of Liberal Arts and Sciences

Spider silks are made up of large, repetitive proteins called spidroins that are encoded by genes from the same family. The protein is originally a liquid within the spider's silk glands where it is produced and stored, but as the liquid moves through ducts to the spinnerets during the spinning process, it transforms into a solid fiber. Spider silk is strong, durable, and flexible, and some types have adhesive properties. This research is focused on two orb-weaving spiders, Verrucosa arenata and Leucauge venusta. Both of these spiders build spiral, wheel-shaped webs using silk secreted from spinnerets at the tip of the abdomen, however they belong to different families. We used the MasterPure Complete DNA and RNA Purification Kit to extract DNA from the two spider species and used the Qubit Assay Kit to quantify the amount of DNA extracted from the spider species. During the remainder of the internship, we will use the extracted DNA to compare the size of silk genes from the two species using custom primers, PCR, and gel electrophoresis. Though belonging to different families, we expect genes to be similar due to similar habitats and target prey.

Title: An Examination of the Effect Tutor-student Relationships have on Reading Intervention Preparedness

Student Author: Rachel Brooks

Faculty Mentor (s): Dr. Erin FitzPatrick

College: College of Education

Current literature around effective reading tutoring shows the valuable impact teachers have on students when they incorporate relationship building into curriculum. Students of any age who have a relationship with their instructor have higher levels of engagement, higher retention rates, and higher rates of high school graduation. Furthermore, elementary aged students particularly benefited from teacher relationships with higher reading self-concept, and higher reading achievement. The Road to Reading program at UNC Charlotte targeted first grade students with early reading difficulties. In response to COVID-19, the program was virtual and featured undergraduate students in their junior year with little to no classroom experience. Prospective teachers were given an initial training before embarking on a bi-weekly forty-five minute structured tutoring with one to two students. The purpose of this study was to investigate the experiences of undergraduate preservice teachers participating in the Road to Reading program. Specifically, this study looks at how relationship building with students effected reading intervention preparedness for tutors. The undergraduate students were interviewed about their experience and results are being generated by qualitative open-coding of the responses. We expect to see that relationship building between preservice teachers and students at risk for specific learning disabilities will enhance the preparedness for delivering reading and alike tutoring. We also expect to see relationship building enhances the satisfaction of delivering instruction to students.

Title: Women's Advice Books of the Seventeenth Century

Student Author: Rachel Crisler

Faculty Mentor (s): Dr. Amanda Pipkin

College: College of Liberal Arts and Sciences

In England from the mid to late seventeenth century, women prepared for premature death primarily due to the dangers of childbirth by writing instructions for their children and husbands. These works included morals that they wished for their children to have, advice on family life, and well wishes. Additionally, in these works, occasionally they would include a letter to the surviving father. Sometimes it was a profession of love, others were instructions of how he should provide a moral and Christian life for their children. Writers of such works included Susanna Bell, Elizabeth Walker, Susannah Wesley, and Elizabeth Jocscelin, along with many others. Titles such as The Legacy of a Dying Mother to her Mourning Children by Susannah Bell and The Mother's Legacy to her Vnborn Childe by Elizabeth Joscelin, give a clear picture as to what the purpose of these texts were. Historians Jean Metcalf and M. Urban describe these advice books as a subgenre of writing in the seventeenth century that became a means for women to communicate their thoughts to their children and families. This research will follow the analyses by Metcalfe and Urban into these texts as written instructions for family life. Further, analyzing how these texts have played a vital role in the next generation's script of morality in their own families. Works by nineteenth century writers such as Robert Lee and John Grutch will serve as a base for tracing references to these works in later generations.

Title: A Case Study of a Serial Murderer: Jeffrey Dahmer

Student Author: Rebecca Wicklin

Faculty Mentor (s): Dr. Charisse T.M. Coston

College: College of Liberal Arts and Sciences

Jeffery Dahmer, one of the United States most notorious serial killers, was active between the years 1978 and 1991 and showed extreme violence in his strangulation, deconstruction, and ingestion of his victims. These combinations of violence are used to make up his signature and led to numerous studies on the Milwaukee Cannibal's life and theories on how he became the monster he did. The focus of this current research study compares the general literature on serial killers to a case study of Jeffery Dahmer. In this review of literature, the nature and the scope, similarities, and differences to literature, as well as, possible additions to the body of research on serial killers will be explored.

Title: Examining Teacher Candidates'/Interns' Undergraduate Preparation for Culturally Responsive Teaching in Urban Public Schools

Student Author: Saad Jalisi

Faculty Mentor (s): Dr. Drew Polly

College: College of Education

In order to match the increasing enrollment of linguistically and culturally diverse students in urban public schools, North Carolina's undergraduate Education Preparation Programs (EPPs) are faced with the challenge of developing culturally responsive and sustaining teaching practices within their Teacher Candidates (TCs). Through multi-semester teaching internships, TCs in urban environments can rehearse implementing culturally responsive teaching under the guidance of university professors and the TCs' respective Clinical Educator (CE); however, preparation for these teaching internships is key in developing culturally responsive pedagogical skills. This research project examines how Teacher Candidates from the University of North Carolina at Charlotte (UNCC) are prepared by the university's undergraduate EPP to produce culturally responsive teaching in P-12 classrooms, and this study analyzes the effectiveness of that preparation through embedded teaching internships in Kannapolis City Schools (KCS). This project will primarily use collected qualitative data from KCS-TC focus group interviews, featuring TCs across the P-12 grade-spectrum. In finding results, this study aims to use the data to improve the university's culturally responsive undergraduate teacher preparation.

Title: SNARE Evolution in the Yeast Minimal Endomembrane System

Student Author: Sarah Moody

Faculty Mentor (s): Dr. Richard Chi

College: College of Liberal Arts and Sciences

A cell's ability to uptake nutrients from the surrounding environment is integral to maintaining homeostasis. Briefly, cargo is internalized into transport vesicles at the plasma membrane and is sent to the early endosome, where it is then sorted through the endo-lysosomal pathway for recycling or degradation through a process called endocytosis. Studies in budding yeast have paved the way in determining the endocytic machinery, and due to the high degree of homology between yeast and metazoans, these findings have often been extrapolated to humans. However, recent studies have shown that budding yeast have a minimal endomembrane system that is fundamentally different from mammalian cells. In yeast, plasma membrane-derived vesicles fuse directly to the trans-Golgi, which acts as an early endosome. Every fusion step in the endocytic pathway is mediated by the Soluble Nsf Attachment REceptor (SNAREs) protein family. We hypothesized that by determining endosomal SNARE evolution in metazoans, we can integrate these findings into a broader understanding of the eukaryotic endomembrane system. Using a molecular phylogenetic approach, we found two major expansions of endosomal SNAREs led to a more complex endomembrane system that is observed in mammals. To confirm our findings, we engineered multiple SNARE knockouts using CRISPR- Cas9 in yeast and determined the SNAREs that mediate plasma membrane to TGN fusion in yeast.

Title: Task Goals Influence Interpersonal Alignment in Referential Expressions and Expressions Indicating Agreement in Joint Tasks

Student Author: Sarosh Ahmad

Faculty Mentor (s): Dr. Alexia Galati

College: College of Liberal Arts and Sciences

A prominent view of dialogue posits that task partners converge conceptually as they align their behavior. This is documented through observing tasks that require partners to actively monitor each other's perspective closely and then documenting the benefits of interpersonal alignment while the task is performed. The goal of this study is to examine the effect of task goals on task performance and interpersonal communication in dyad dialogues. In this study, dyads interacted with maps to complete 10 trials under different task goals: 5 trials involved planning a route from an origin to a destination (route planning) and 5 involved searching for landmarks (visual search). We transcribed a subset of the dialogues in detail. In each conversational turn, we coded for the presence of acceptances (e.g., mm-hm, yeah), references to landmarks, and the use of metacomments (comments about the state of the task) through which task partners negotiated strategies. This presentation will focus on the presence of acceptances and references to landmarks. Route-planning entails more perspective-monitoring of the partner's subgoals in the task, leading us to believe that we will find more acceptances and a stronger alignment in the use of landmarks in those tasks compared to visual search. Our findings would suggest that speakers use linguistic strategies differently across tasks, in a way that serves task goals.

Title: Building a User Webservice for Few-Shot Keyword Spotting

Student Author: Shaishav Maisuria

Faculty Mentor (s): Dr. Minwoo Lee

College: College of Computing and Informatics

Recognizing a keyword from audio input is often seen in many virtual assistant technologies such as Alexa, google home and Siri. AI systems usually use a complex neural network to spot, identify and recommend newer suggestions with the help of large training samples. However, training a deep neural network often requires a large dataset which often requires large memory consumption and immense computation power. In addition, predefined keywords over a large number of samples restrict the ability of the models to recognize new user-defined keywords. Thus, we develop the few-shot keyword spotting model using prototypical networks, where keyword spotting is performed over new keywords that only use minimal samples. Therefore, it is easier to deploy on the server without training on extensive deep learning neural networks. The project's primary goal is to create a website that relies upon a small input dataset by processing the model to provide a real-world application for the experimental concept of few-shot keywords without creating the need for a large dataset, high computational resources. The main components designed during the website building are interactive user frontend, model processing, data storing, and other back-end processes on the server. The website framework displays the output based on the selected classification model using user input in audio sample sets, query sets, background noise sets, and preprocessing upon the newly provided query set directly to the website. The features intended during the website building helps to apply the few-shot keyword spotting, which is an audio classification problem, allowing a user to spot keywords without requiring the need to provide large training datasets.

Title: The Use of Standardized Tests to Assess Social-Emotional Development in Foster Children

Student Author: Skylar Grams

Faculty Mentor (s): Dr. Charlene Whitaker-Brown

College: College of Health and Human Services

Children in the foster care system are more likely to experience adverse childhood experiences (ACEs). ACEs lead to an increased risk of toxic stress, impacting proper social-emotional development. The Ages and Stages Questionnaire: Social-Emotional (ASQ:SE) is recommended to assess social-emotional development. However, many doctors who work with transitioning foster children rely on observations of the patient rather than standardized tests. This project aims to determine if the administration of the ASQ:SE will accurately identify social-emotional problems, leading to more appropriate treatment. A secondary analysis of 20 articles was conducted to review existing literature to critically evaluate and appraise evidence related to the project. Keywords included: foster children welfare system, social-emotional development, standardized tests, standardized screening tool, ASQ:SE, provider surveillance, adverse events, and clinical surveillance. The literature supported the use of standardized tests to identify social-emotional problems in young children and supported the implementation of the ASQ:SE in clinical practice. The ASQ:SE notably detected more social-emotional developmental problems in elementary-aged school children. As seen in the existing literature, the use of standardized tests, specifically the ASQ:SE, can be an effective tool in detecting social-emotional problems in foster children in a clinical setting.

Title: Growth and Goals: Analyzing how Participants' Skills and Knowledge Grow During an Arts Program and Examining the Program's Goals for Social Impact.

Student Author: Sofia Escotto-Pimentel

Faculty Mentor (s): Dr. Vaughn Schmutz

College: College of Liberal Arts and Sciences

Many nonprofit organizations in Charlotte provide arts-based programs to youth with missions that focus on enhancing proficiency in the arts to benefit other aspects of their lives, including self-empowerment and growth, social change, therapy, and attainment (especially educational). The goals of the study are to explore how participants develop their knowledge and skills over the duration of their program, as well as analyzing the goals of the program in relation to social impact. This will be a case study of Lórien Academy of the Arts, which provides middle and high school students visual arts summer classes to enhance their confidence, creativity, and critical thinking to be applied to other areas of life. Qualitative methods will be used to analyze how Lórien's participants' skills and knowledge of visual arts progress over the course of the program using weekly video logs that describe their learning and creative process. The logs will be used to assess participants' growth and confidence over the program's duration based on their ability to elaborate on the creative process using concrete or tangible language. The study will also examine Lórien's goals and beliefs on arts and social impact based on both a semi-structured interview with the director and available public statements. Results are expected to indicate that participants' level of confidence and ability to elaborate on the creative process will grow throughout the program as they acquire more skills and knowledge.

Title: Freelon's Community Impact Through Architecture

Student Author: Tahlya Mock

Faculty Mentor (s): Dr. Emily Makas

College: College of Art and Architecture

Architecture has experiential qualities that have an immense impact on the people that inhabit it and move through it. Phil Freelon, now passed, was a passionate African American Architect who was known for being the 'main man' for any and all African American cultural projects in Durham, North Carolina and eventually the entire United States. His goal was to "work on buildings that made a positive impact on the communities where they are built." The aim of this research was to demonstrate the impact of Freelon's work on the African American communities surrounding his built designs. I focused on Phil Freelon's multiple civic building projects in the Durham, NC area as well as his work on Historically Black Colleges and University (HBCU) campuses throughout the United States. I also reviewed his work at the National Museum of African American History and Culture in the United States Capital. I read newspaper articles, listened to interviews, viewed visual media and toured some of the buildings Freelon designed. The Durham community has experienced favorable transformative changes in the physical environment around them, and HBCU campuses have helpful new facilities that improved the quality of the education being taught. I also found that many African Americans in the U.S. applauded our cultural identity being commemorated in an uplifting way on a national level. Phil Freelon was successful when he set out to positively impact the African American communities in the U.S. with the use of his designs.

Title: Preservice and Practicing Teacher Perspectives on Teaching For Social Justice in English Language Arts (ELA)

Student Author: Tara Gabriel

Faculty Mentor (s): Dr. Heather Coffey

College: College of Education

Existing research has shown the need for preservice (PST) and newly licensed teachers to be knowledgeable about teaching for social justice. This qualitative research study, incorporating a culturally relevant education (CRE) theoretical framework, examines the perspectives of preservice and practicing teachers on what it means to teach for social justice and to be a critical English educator. Furthermore, how to incorporate social justice topics and culturally relevant teaching into classroom instruction and standard-based curriculum. Purposeful sampling, combined with criterion sampling, was utilized to gather PST and current practitioners; all participants have completed the methods courses in the Middle Grades or Secondary Education program at UNC Charlotte. The methodology of the study includes pre- and post- participation surveys, bi-directional interviews (between PST and practitioners), and focus group discussions (whole-group oriented) related to critical English education pedagogy. The data collected will be triangulated and member checking for coding consistency throughout the study. A formulation of inductive codes and core categories will be presented in hopes of better understanding current challenges, strategies, and perspectives of critical pedagogy in the field of education, more specifically, in the English content area. A limitation of this study would be its small sample size, raising possible concerns of replication to a larger population. The researchers anticipate the findings between the learned knowledge about critical pedagogy and applied praxis in the classroom environment to be progressive throughout the study as preservice and current practicing teachers reflect and learn from each other.

Title: Creating a Bystander Intervention Program to Reduce Problematic Alcohol Use Among College Students

Student Author: Victoria McClare

Faculty Mentor (s): Dr. Annelise Mennicke

College: College of Health and Human Services

BACKGROUND: Problematic alcohol use (PAU) is an issue among college students in the United States. PAU is comprised of different behaviors leading to negative consequences such as, risky decisions, use of alcohol to cope, restrictive diet, binge drinking, and alcohol use disorder. Over 1,500 college students died from alcohol-related unintended injuries in 2014. A proposed answer to PAU is a peer-based bystander intervention to reduce drinking and its related consequences among college students. Bystander interventions have been shown to be effective at reducing rape myths, dating violence acceptance, drunk driving, bullying, and sexual violence among college students. PURPOSE: This project will create an outline for a peer-based bystander intervention program in which college students will be trained in how to use helpful bystander behaviors to prevent PAU and related consequences. METHOD: Following the steps of intervention mapping, an evidence-based health promotion process to plan an intervention, this project will identify the health problem, decide the target group's desired health-promoting behaviors, and brainstorm ideas for intervention. Additionally, I will develop the initial overall structure of the intervention and create implementation strategies. RESULTS: Anticipated outcomes of this project include an outline for an intervention consisting of multiple one hour-long in-person sessions. Sessions will be tailored to specific groups such as athletes, first-year students, and minorities in which a respected figure from those groups will be leading the program. CONCLUSION: This intervention is anticipated to reduce PAU by using a peer-based bystander approach.

Title: Analysis of Data Collection Methods for Assessing Health-Risk Behaviors Associated with Sexting

Student Author: Vijitha Mallineni

Faculty Mentor (s): Dr. Erika Montanaro

College: College of Liberal Arts and Sciences

Introduction: Prior research on sexting and its association with health-risk behaviors has utilized either a survey method or content analysis of text messages for data collection. Both methods have advantages and disadvantages. A survey method is beneficial given its simplicity for researchers and ability to provide anonymity to participants. However, self-report methods are prone to reporting biases; for example, people misremembering events surrounding sexual activity. Content analysis of text messages, on the other hand, provides naturalistic assessments of communication patterns between sexual partners; however, this method can be viewed as invasive. It is unclear which method should be used for specific research questions related to sexting or if a combination would offer insight into sexting and broader health-risk behavior patterns. The purpose of this study is to help develop a framework for determining when each method should be used given a specific behavioral domain and research question.

Methods: A literature review of relevant research studies will be conducted to explore risk behaviors associated with sexting among young adults (e.g., alcohol consumption).

Results: A decision tree will be created in order to help researchers decide on which data collection technique is most appropriate given their behavioral domain of interest and research question.

Conclusions: As technology-mediated communication (i.e., texts) become even more enmeshed in our everyday lives, accurate data about its use will allow researchers to better understand how and when it is used to discuss sensitive health topics, which, in turn, will allow for the development of better prevention programs.

Title: Probing Structure and Function of Telomerase

Student Author: Zarin Khan

Faculty Mentor (s): Dr. Kausik Chakrabarti

College: College of Liberal Arts and Sciences

Telomeres ensure chromosomal replication and protection in eukaryotic organisms. These non-coding repetitive DNA sequences cap the chromosomal ends and are essential for genomic integrity and continuity of cell viability. Telomerase is a cellular ribonucleoprotein enzyme that regulates and maintains telomeres by controlling telomere lengths. Telomerase reverse transcriptase (TERT) and telomerase RNA (TR) are two main components of telomerase. Telomerase RNA (TR) provides the template for DNA repeat synthesis which is essential for genome stability. TERT is a protein coding gene that provides instructions for making Telomerase Reverse Transcriptase enzymes. The abnormality of telomere lengths correlates to aging and cellular proliferation. The parasitic protist, Trypanosoma brucei, is a microscopic protozoan that causes a disease known as African Sleeping sickness in humans. In parasitic diseases, increased lengthening of telomeres trend has been linked to the continuous proliferation of the pathogens within their host. Therefore, studying the telomerase function for telomere synthesis is significant for these protozoa to develop therapeutics. Telomeres are generally synthesized during the S-phase of the cell cycle. Two different proliferative stages of T. brucei are Procyclic forms (Insect Stage) and Bloodstream forms (Mammalian stage). However, the relative expression of T. brucei telomerase components and telomerase activity for telomere synthesis in different stages (Procyclic and Bloodstream forms) is unknown. In this study, T. brucei will be cultured and chemically treated to arrest the cells at the S-phase of the cell cycle. Western blot will be used to measure the abundance of telomerase reverse transcriptase (TERT) protein, and RT-PCR was used to measure T. brucei telomerase RNA from both cytoplasmic and nuclear fraction of T. brucei cell extracts. Ultimately T. brucei telomerase activity will be measured with a laboratory-optimized assay. Overall, findings from this project can aid our understanding of the molecular mechanism of telomerase function in human pathogens such as Trypanosoma brucei.

Shaping Experiential Research for Veterans Education Program

Title: Identifying the Steering Dynamics of an Autonomous Surface Vessel

Student Author: Jacob Armiger

Faculty Mentor (s): Dr. Artur Wolek

College: College of Engineering

Autonomous surface vessels (ASVs) are unmanned boats that can be used to automate data collection and reduce the need to perform manual, labor intensive sampling tasks in applications such as environmental monitoring or infrastructure inspection. However, automating an ASV can often be challenging since it requires extensive outdoor testing and steering controllers may be sensitive to platform changes, such as the addition of new payloads, biofouling, or assembly variations. In this research, a method for data collection and steering dynamics identification is being developed for steering controller design and tuning of a fleet of ASVs under development at UNC Charlotte. Data is collected using an Arduino to capture human throttle/steering inputs (as pulse-width-modulation (PWM) commands from a handheld radio transmitter), and the vehicle response measured by a GPS and inertial measurement unit (IMU) is logged to an onboard computer. An onboard MATLAB program uses an SQL library to consolidate and store the data. Experimental input and output data are used to explore different models for steering system identification, such as Nomoto's first-order model. Both experimental and simulated data are used to compare our predicted ASV dynamics with a validation data set. If successful, our method will allow us to rapidly identify models of ASV steering dynamics to support follow-on automation tasks, such as waypoint following and multi-vehicle collaborative sampling.

Summer Research Participants

Title: Spectral Analysis of Geometric Shape Motion at Hypersonic Velocities

Student Author: Bradley Edwards

Faculty Mentor (s): Dr. Jerry Dahlberg

College: College of Engineering

Objects traveling at hypersonic velocities often vibrate strongly. In this research, we experimentally measure the physical motion of a circular cross-section tapered probe at Mach = 5. Using a high-speed data acquisition system, as well as external accelerometers, we record the accelerations in three orthogonal directions. Using a Fast Fourier Transform (FFT) on the acceleration data to generate the spectral response, we then break down the motions into frequency bins correlated to the computational model calculated modes of vibration.

Title: Characterizing Radio Communication Range for an Autonomous Surface Vessel

Student Author: John Driver

Faculty Mentor (s): Dr. Artur Wolek

College: College of Engineering

Autonomous surface vessels (ASVs) are unmanned boats that operate on the surface of a body of water for a variety of purposes, such as scientific data collection. Low-cost ASVs that rely on radio communication (rather than global services, such as Iridium) have a limited communication range, which can lead to a loss of vehicle control during long distance operations. This research aims to characterize the range and reliability of the radio-based communications systems used by a fleet of ASVs under development in the Autonomous Robots and Systems Laboratory (ARSL) at UNC Charlotte. The ASVs use three forms of outdoor communication: (1) a 900 MHz XBee serial radio modem for long-range telemetry and control, (2) a 2.4 GhZ Spektrum DX8 remote control (R/C) transmitter/receiver for manual control, and a (3) NETGEAR Nighthawk Wi-Fi Router for short-range networking. An experiment will be conducted to test each outdoor communication system's range and reliability on land to simulate its ultimate use in a freshwater lake. Signal strength data from the XBee radio and Wi-Fi router will be recorded in MATLAB, while the hand-held R/C transmitter signal strength will be recorded manually by inspecting the transmitter display. The test will involve data collection while moving over one kilometer in a straight line. The data collected will enable determining the area that an ASV can operate without losing communication to a ground control station to support reliable mission planning for ongoing robotics research.

UNCC-LSAMP

Title: Providing Equitable Access to Computer Science 1

Student Author: Giselle Cabrejos

Faculty Mentor (s): Dr. Dale-Marie Wilson and Dr. Marlon Mejias

College: College of Computing and Informatics

Research from many universities across the country has shown that the dropout/fail rate for the introductory course in computer science is unexpectedly high, approximately 33%. While evidence shows that the main contributing factor to success in these courses is motivation. There is still considerable effort to identify those underlying factors. This research will investigate whether prior computing experience, connectivity to computer science and a peer support community are contributing factors to a student's success in our introductory computing course. This project will build on previous research that conducted surveys to gather information on why students dropped out of the introductory course and/or the computer science major as well as which topics in the introductory course were the most difficult to grasp. This project will develop a Forty-niner Intensive Training (FIT) course that will be piloted in the mini-fall semester. The curriculum will include computing concepts, exposure to the pervasiveness of computing as well create a peer community of support. The participating research students will also serve as peer mentors for the FIT course. A user study will be designed to evaluate the efficacy and perceptions of the course. We predict that there will be a significant improvement in the performance in the introductory computing course and sense of belonging of the students that participate in the FIT course."

Title: Behavioral and Genetic Responses to Thermal Stress in Fiddler Crabs

Student Author: Ifeoluwa Onasanya

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

College: College of Liberal Arts and Sciences

As global warming progresses, the geographical ranges of many species around the world are shifting. Fiddler crab species (>100 identified) live in intertidal zones around the world and have large geographical ranges, making them ideal candidates for studying behavior and genetic responses to thermal stress. The Atlantic sand fiddler crab, Uca pugilator, ranges from Florida to Massachusetts and in the northern Gulf of Mexico. The objectives of this project were (1) to compare the environmental conditions male, female, and ovigerous female crabs experience in their habitat during the reproductive season and (2) to evaluate potential genes that respond to thermal stress and may be responsible for the production of a group of highly conserved proteins known as heat shock proteins (HSPs) in U. pugilator. To monitor the environmental conditions experienced by fiddler crabs, temperature and tidal data were collected at the Baruch Marine Field Laboratory in Georgetown, South Carolina. Predicted tidal data and observed water levels were downloaded from the NOAA Tides and Currents website. From June-July 2021, temperature data was collected using HOBO TidBiTv2 temperature loggers deployed at the surface of the mud flat and at 15 cm and 30 cm below the surface. Candidate genes associated with thermal stress were evaluated by comparing thermal sequence data (NCBI) to the existing transcriptome for U. pugilator. Sequence data was analyzed using the bioinformatics software Geneious. Studying the response of U. pugilator to thermal stress will enhance our understanding of how species in intertidal habitats respond to warming temperatures.

Title: Wild Soybean (Glycine soja) Genetics: Uncovering the Genetic Variation of Soyasaponin Abundance

Student Author: Jamari Tyson Faculty

Mentor (s): Dr. Bao-Hua Song

College: College of Liberal Arts and Sciences

Soyasaponins are a group of specialized metabolites rich in the legume species, such as soybeans. Soybean is a staple crop rich in plant-based protein, oil and micronutrients. Numerous studies have been conducted to improve and strengthen current soybean cultivars. Soyasaponins have been an emerging research interest due to its crucial roles not only in plant defense, but also in human health benefits, for example, lower incidences of chronic disease, inflammation inhibition, and carcinogenic suppression. To develop soybean cultivars with improved soyasaponin production via plant metabolic engineering or molecular breeding, understanding the underlying molecular mechanisms and biosynthesis pathway of soyasaponin is a critical first step. This research focuses on a unique study system, wild soybeans, which have been shown to be genetically diverse, and thus, an asset for biological information. One of the candidate genes (SOYD1) encoding an enzyme responsible for soyasaponin production has been identified with a genomic approach. Initial sequence analyses of SOYD1 using six wild soybean ecotypes showed coding sequence variation leading to amino acid changes between high- and low- soyasaponin production ecotypes. Further investigation of sequence variation of this gene with more ecotypes will validate the contribution of the candidate gene in conferring variation in soyasaponin abundance. This study will shed light on the molecular mechanism of soyasaponin variation and provide a foundation for improving soyasaponin production in crops and developing alternative medicines for human health.

Title: Understanding Inter-Chromosomal Homologous Recombination to Repair Chromosomal Double-Strand Breaks in the Pancreas

Student Author: Jordan Foster, Kiran Lalwani

Faculty Mentor (s): Dr. Christine Richardson

College: College of Liberal Arts and Sciences

Illegitimate repair of chromosomal DNA breaks can result in mutations and chromosomal translocations which have links to various cancers and diseases. Homologous recombination (HR) is a major pathway responsible for the repair of these DNA breaks. To develop a full understanding of how DNA breaks are repaired in living organisms, a unique "Rainbow Mouse" mouse model was developed. This model introduces specific site breaks in DNA by doxycycline induction of I-SceI endonuclease expression that promotes repair by inter-chromosomal HR resulting in expression of the green fluorescent protein (GFP+). The purpose of this research is to determine the balance of legitimate HR versus illegitimate HR and chromosomal translocations within specific pancreatic cell sub-populations. To evaluate inter-chromosomal HR frequency within the pancreatic cells, I-SceI expression is induced to generate DNA breaks. Then islet cells, acinar cells, and duct cells are identified using anti-insulin, amylase, and DBA lectin antibodies respectively. Fluorescent microscopy, flow cytometry, and immunohistochemistry are all used to analyze the cells to identify the pancreatic cell sub-types and GFP fluorescence. I hypothesize that GFP+ cells and HR will occur more often in early progenitor cell types than in differentiated cells in the pancreas. Additionally, I hypothesize body weight will play a significant role in the inter-chromosomal HR GFP+ frequency in the different cell types. Overall, studies in the "Rainbow Mouse" model will allow us to better understand how incorrect repair of chromosomal DNA breaks can result in genome instability.

Title: Characterization of Nanomaterials

Student Author: Kennedi Briggs

Faculty Mentor (s): Dr. Rosario Porras-Aguilar

College: College of Liberal Arts and Sciences

This project focuses on the absorption of low power continuous wave (CW) beams in azo-benzene liquid crystals. The use of liquid crystals as an alternative to label-imaging in microscopy has been proven and discussed extensively. Azobenzene liquid crystals with a push pull (trans) π-π conjugation have high sensitivity to CW beams and the largest birefringence of any materials in the visible spectrum. The absorption of light from cw beams, is almost instantaneous, and the liquid crystal molecules remain in an excited state for 30 hours[2]. As a result, the use of azobenzene liquid crystals offer "real-time adjustment of the contrast in images and prolonged-time observation." Due to the low intensity of light absorbed by the LC, cell cultures or other mediums being studied are at a much lower risk of damage due to light. In addition to label-free imaging, liquid crystals offer a less expensive, faster, and longer-lasting alternative to popular imaging techniques used today, namely spatial light modulators or SLMs[1]. Knowing the potential of liquid crystals in microscopy, the purpose of this research is to optimize their use by finding the absorption coefficient and absorption spectra of the molecules, as well as to find an optimal thickness for cells containing the LC materials.

Title: Rheology Testing: Outdoor Pools and The Impact of Natural Products on Hair and Skin

Student Author: Lisa Ricanek

Faculty Mentor (s): Dr. Felesia Stukes

College: College of Computing and Informatics

Many people spend their summers outdoors and at the pool. Going to an outdoor pool could be a fun activity for you and your family or it could be used for aerobic exercise. This project will look at the external factors of going to an outdoor pool and find a possible natural solution. These factors include the sun and chemicals found in the pool. Due to the sun causing sunburn, dryness to the hair, skin cancer, and aging skin it is important to protect the skin from the sun. Chlorine in the pool can cause dryness of the skin which leads to eczema and dermatitis. Most people use sunscreen but due to the different chemicals found in it, some might not like using it. During this research test will be conducting to find a natural sunscreen and its benefits. A rheology test will be done on the natural sunscreen to determine the viscoelastic properties.

Title: UNCC GenCyber Teacher Camp: Preparing Elementary through High School Teachers to Incorporate GenCyber Concepts and Principles In STEAM Classes

Student Author: Shaina Flournoy

Faculty Mentor (s): Dr. Marlon Mejias

College: College of Computing and Informatics

This particular research was conducted as the teacher camp version and aided in providing teachers with knowledge of basic cybersecurity principles and concepts while helping to create a lesson plan for their future classes.The purpose of this research was to provide teachers with confidence in teaching cybersecurity to their respective students. To conduct this research, first a survey was sent out to all participants to determine the level of preparedness and confidence each had in cybersecurity concepts and teaching them. Then, the week-long camp was held from Monday July 21- 25, 2021. Monday, Wednesday, and Thursday were held virtually while Tuesday and Friday were in-person. Each day consisted of reviewing cybersecurity concepts and principles, professional development, guest speakers within the field, activities, and allotted lesson planning time. Friday included the previously mentioned agenda along with a final presentation for each group of teachers to present the lesson plans they created aligning with their classes and grade levels taught. Also, a review Kahoot game was played along with a certificate of participation for the completion of the GenCyber Teacher program was given to all participants. Finally, a post survey was sent out for participants to complete to measure their confidence in teaching cybersecurity after completing the program. Overall, the GenCyber UNCC Teacher program was successful and created new opportunities for the teachers and their students to be exposed to cybersecurity.

Title: Causality and Machine Learning Models

Student Author: Shaneice Board

Faculty Mentor (s): Dr. Gabriel Terejanu

College: College of Computing and Informatics

Machine learning allows for the creation of refined and quantifiable representations of information. For an adequate representation of information, it is necessary to understand the reason behind the presentation of information. Predictive systems that are only correlative are not suited for reasoning under user-related interventions and are subject to bias. Machine learning that incorporates causality assists in building stable, fair, and reliable machine learning models. Causality is needed for data-informed decision-making and addresses the reason that an outcome occurs. In addition to this, causality also provides an additional representation of information. Causal machine learning focuses on predicting outcomes and identifying associations, such as understanding the reasoning behind user behavior in online systems and the impact of social policies. The concern of cause and effect that causality provides is crucial for designing machine learning models and data-driven applications. A Cytoscape template using Vue.js was expanded on to allow for quantifiable representations and introduce bias. Cytoscape, JavaScript, and Vue.js were used to contribute to the interface design of causal machine learning models. In addition to additions made to the user interface of the machine learning model, research was conducted on the importance of causal models, bias and machine learning, and predictive systems. This research allowed for a platform that aids in building causal machine learning models to be expanded. This platform allows users to bring in data, train the machine learning model, introduce bias using the interactive Cytoscape graph, and view the history model training done using the platform.