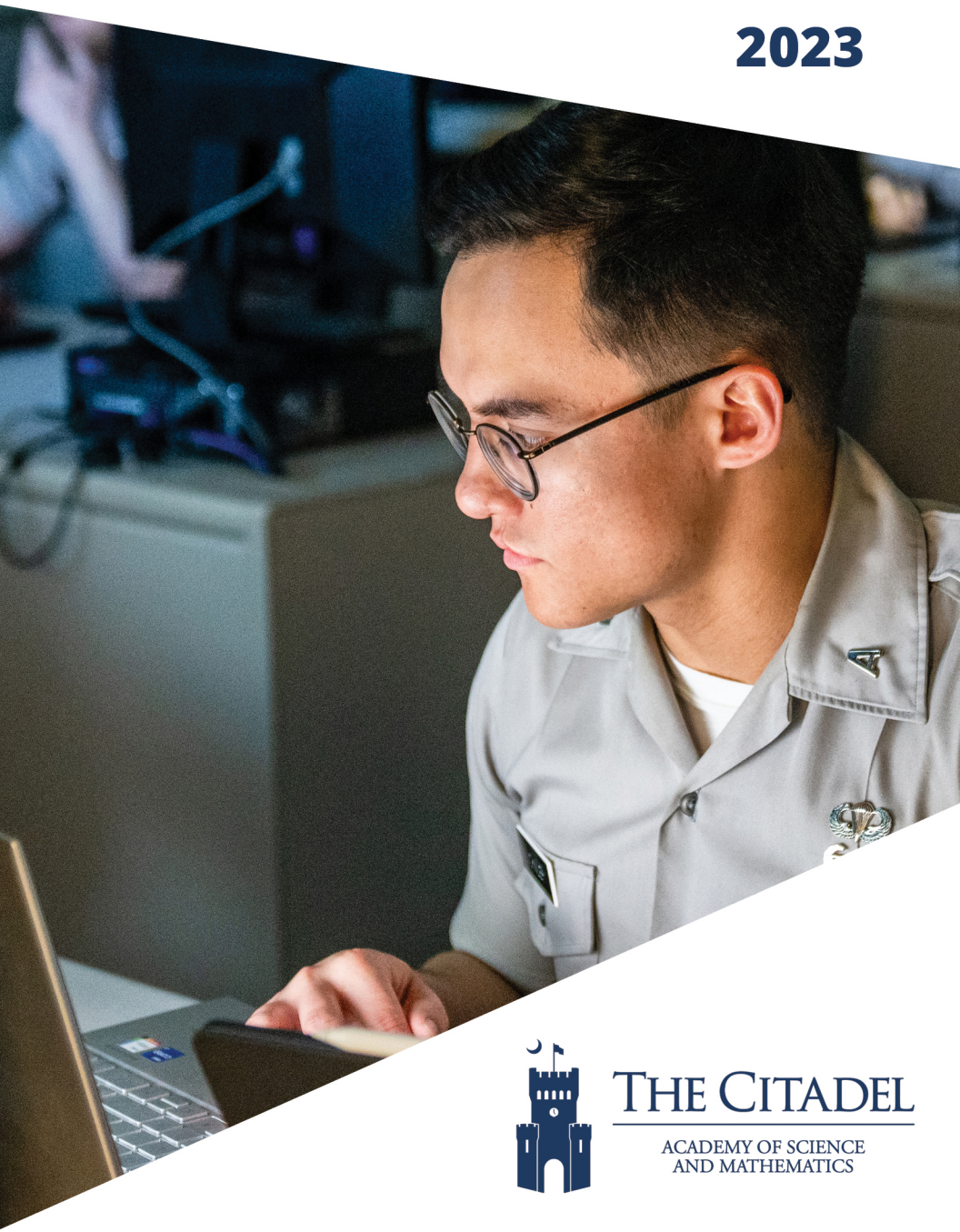
CITADEL ACADEMY OF SCIENCE AND MATHEMATICS

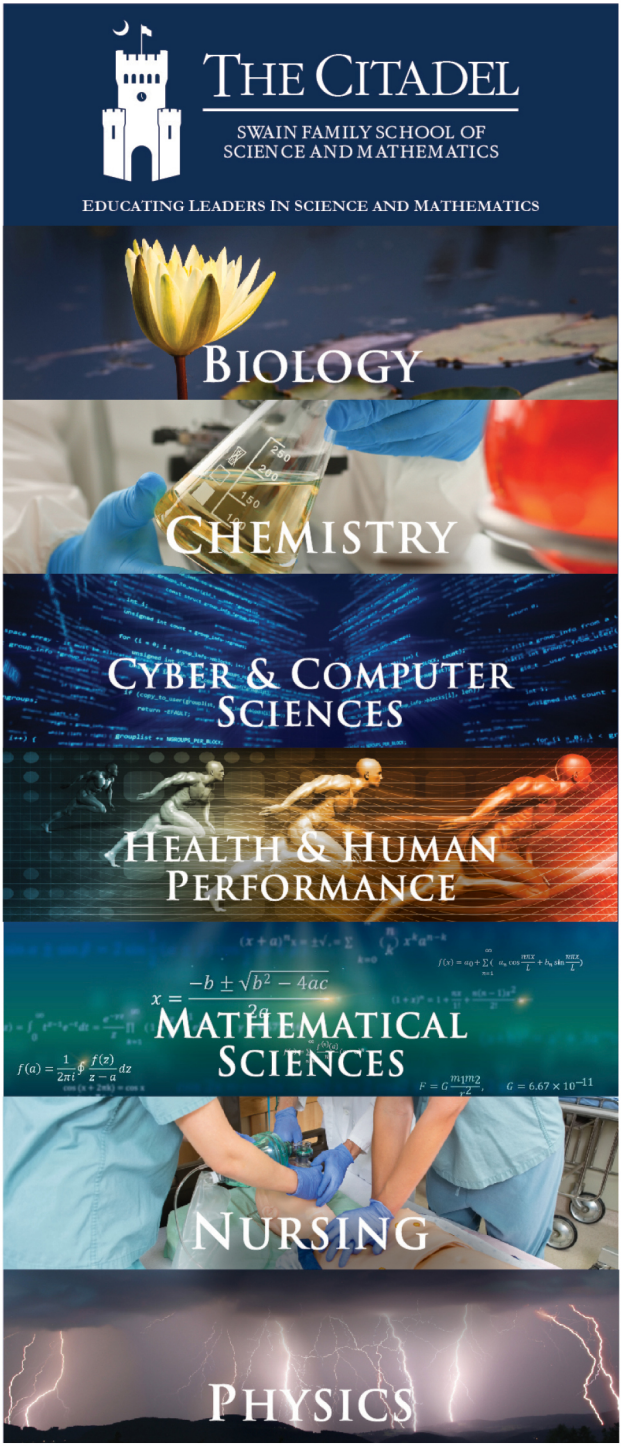
RESEARCH ABSTRACTS

2023



THE CITADEL

ACADEMY OF SCIENCE AND MATHEMATICS


THE CITADEL
SWAIN FAMILY SCHOOL OF SCIENCE AND MATHEMATICS
EDUCATING LEADERS IN SCIENCE AND MATHEMATICS
BIOLOGY
CHEMISTRY
CYBER & COMPUTER SCIENCES
HEALTH & HUMAN PERFORMANCE
MATHEMATICAL SCIENCES
NURSING
PHYSICS

CASM Celebration

MARCH 23, 2023

Dear Friends,

I'd like to personally welcome each of you to the 2023 Citadel Academy of Science and Mathematics (CASM) Awards Celebration. It is an exciting time for us as we recognize distinguished alumni and faculty with their induction into our Academy. At the same time, we celebrate the outstanding academic achievements of our students and faculty.

This evening we display examples of research that our students and their faculty mentors are doing as an integral part of their Citadel education. As faculty and staff, our primary mission is to be of service to our students. From first year cadets to graduate students, we relish the opportunity to help them think critically and then present their thoughts precisely and persuasively. Their achievements before they graduate, and their successes beyond The Citadel gates, give special meaning to our vocation.

I hope you'll have an opportunity to reflect on the hard work that goes into students' research projects, and the transformative impact that these experiences have on our students. Proceeds from tonight's event will go towards continued support of the students and programs within the School.

This celebration event was made possible by the dedication of many staff, faculty, students, and alumni. Special thanks go to Ms. Vanessa McFadden, Fred Holland, The Citadel Science and Mathematics Council Recognition Committee, Zane Jernigan, and Bobby Houck at The Citadel Foundation. We owe a special debt of gratitude to the generous support of tonight's sponsors and the friends of the Swain Family School of Science and Mathematics.

Thank you for your presence this evening. Enjoy this celebration of academic leadership excellence in science and mathematics!

Sincerely,

Darin Zimmerman, Ph.D.
Dean and Traubert Chair
Swain Family School of Science and Mathematics

Student Research Presenters

Department of Biology

Cadet Mary C. Ballentine '23
Cadet Timothy Goike '23
Cadet Jesse Murdaugh '23
Philip A. Newman '23
Cadet Rion Zack Reynolds '23
Cadet John A. Shirley '23
Cadet Savannah S. Fisher '24

Department of Chemistry

Cadet Evans Banks '23
Cadet Nicholas R. Herzler '23
Cadet Corbin Snavely '23
Cadet S. Evan Stravolo '23
Cadet Angela '24
Cadet Sarah Fink '24
Cadet Gavin Coulter '25

Department of Cyber and Computer Sciences

Cadet Hannah Collee '23
Cadet Slateon Frederick '23
Cadet Dalton Hazelwood '23
Cadet Justin Hedges '23
Cadet Benjamin Prins '23
Ms. Maria Marquez-Garcia CGC '23
Cadets Sharize Roper '23,
Cadet George Honiotes '24
Cadet Sebastian Klincewicz '24
Cadet Brian Mutua '24
Cadet Jacob T. Wood '24

Department of Health & Human Performance

Cadet William Templeton '23
Cadet Caleb Raab '23
Cadet Benjamin Johnson '23
Cadet Jesse Young '23
Cadet Suzuka Yosue '23
Ms. Tatiana Corso CGC '23
Ms. Sarah Quinn CGC '23

Department of Mathematical Sciences

Cadet Ernest James '23
Cadet Sadie Gomez '25
Cadet William Boyd '25
Cadet Megan Karcher '26

Swain Department of Nursing

Cadet Arista N. Couture '23

Department of Physics

Cadet Jesse Quimby '23
Cadet Kohl Hammer '23

BIOLOGY

Author/Presenter: Savannah S. Fisher '24

Faculty Mentors: Dr. Clinton J. Moran & Dr. John D. Zardus

Title: Temperature impacts on biofouling barnacle locomotion

Poster Abstract: Seawater temperature is an important driver of marine organism distributions and many species' ranges are predicted to expand with climate change. For instance, temperate and tropical barnacles are expected to shift poleward as temperatures increase. Adult barnacles live immovably attached to surfaces and as "biofouling" organisms inflict billions of dollars in damage and lost efficiency to marine industries. They spread as mobile larvae that swim in the plankton. To better understand the effect of water temperature on larval barnacle swimming, we tested how reduced and elevated temperatures impact their locomotory kinematics. In the laboratory, we reared larvae from eggs collected from adults in Charleston Harbor of the striped barnacle (*Amphibalanus amphitrite*), a tropical to temperate biofouler, After raising them to the attachment or cyprid stage, we used high-speed videography (1,000 frames per second), to analyze differences in their swimming kinematics at cold, intermediate, and warm temperatures (18, 24 and 30 °C respectively). We found that cyprids, relative to body size, reach some of the fastest swimming speeds known among animals and that temperature significantly impacts their swimming kinematics. Animals in cold-water traveled the farthest per swim-beat cycle while those in warm-water had faster strides, ultimately traveling farther per unit time than their cold-water counterparts. Our results indicate elevated ocean temperatures will facilitate swimming in this biofouling organism and its spread to habitats it was once unable to occupy.

Acknowledgements: We gratefully acknowledge the Near Center for Climate Studies for providing funding for this research.

Author/Presenter: Rion Zack Reynolds '23

Faculty Mentors: Dr. Clinton J. Moran & Dr. John D. Zardus

Title: Barnacles in hot water: temperature impacts on feeding behaviors of the striped barnacle

Poster Abstract: Future climate warming will impact organisms in a variety of ways as cold blooded organisms are subject to environmental temperatures. Changing environmental temperatures can impact everything from metabolic rate to reproduction. This is particularly important for organisms that are sessile and cannot move to find thermally optimal temperatures. We aimed to understand how temperature impacts feeding behavior of the striped barnacle (Amphibalanus amphitrite). This barnacle is a biofouler that can be found in the Charleston Harbor. We measured feeding structure velocity during barnacle feeding. Specifically, we measured average opening and closing velocities of cirri (feeding structures) at 18, 24, and 30 °C. With these data we can ascertain how temperature impacts feeding behaviors which ultimately results in changes in fitness. These changes in fitness can have financial implications as increased survivorship will result in greater costs to marine industries as a result of biofouling.

Acknowledgements: Dr. Bowers' Research Presentation Award and Near Center for Climate Studies

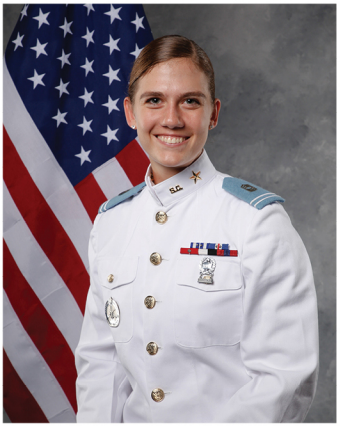
Author/Presenter: Timothy Goike '23

Faculty Mentor: Dr. Danny Gustafson

Title: Piedmont Mountains Biodiversity at Georgia's Underground Marble Mines

Poster Abstract: Imerys, an international minerals company, is moving to promote biodiversity at its mining sites. The goal of this summer study was to survey company property to create and establish a 'Biodiversity Action Plan' for two marble mine sites in Marble Hill and Whitestone, Georgia. This plan involved mapping the property, minimizing habitat loss, pollution management, invasive species management, biodiversity training, and partnership establishment. The World Database for Protected Areas and the International Union for Conservation of Nature provided protected areas and initial research for endangered species. Using game cameras, personal cameras, and submissions from site employees, I established a list of 21 fauna and four flora species. The Hierarchy of Mitigation implementation produced plans to rehabilitate inactive areas no longer in use. Marble dust was the most significant pollutant at the site, with mitigation efforts including settling ponds, misting cannons, and truck washes. Pesticide and Herbicide usage are set to cease by the end of 2023. During surveying, invasive species were not found. Protected Areas were marked with signage to prevent accidental entry. All site employees and visitors undergo site-specific training with an included biodiversity section.

A**cknowledgements:** Dr. Gustafson and Imerys



Author/Presenter: Mary C. Ballentine '23

Faculty Mentor: Dr. John E. Weinstein

Title: Atmospheric Deposition of Microplastics and Tire Wear Particles in Marsh Habitats: Relationship to Meteorological Factors

Poster Abstract: Sources and pathways by which microplastics enter coastal waters remains poorly understood. While studies have documented the presence of microplastics in urban atmospheric samples, there is currently a critical gap in our knowledge regarding the contribution of this pathway in salt marshes. The purpose of this study was to determine the contribution of atmospheric deposition of microplastics, including tire wear particles, into four salt marsh and salt marsh-adjacent sites around Charleston Harbor. To accomplish this, we collected samples using stainless steel buckets (324 cm2) through passive deposition during both wet and dry periods. After a duration of between 1 and 7 days, retained particles were filtered onto glass fiber filters and visually analyzed under a dissecting microscope. Results indicate that atmospheric deposition of microplastics at these four sites ranges from 88.2 to 3,458 microplastic particles/m2 / day. Microplastic abundance varied among the four sites, with the highest abundances associated with the salt marsh adjacent to the Ravenel Bridge (2,573 MP/m2 /day average ± 511.95 SE). Future research will investigate the relationship between particle deposition at these sites and meteorological factors (wind speed and direction, and precipitation). These will help us better understand the pathways and fate of these particles in our coastal waters.

Acknowledgements: This project was funded by the Lt. Col. James B. Near Jr. USAF, '77, Center for Climate Studies.

Author/Presenter: Jesse Murdaugh '23

Faculty Mentors: Paul Culver, MD/PhD Candidate and Dr. Mary Katherine Zanin

Title: The Role of Centrally Acting Cholecystokinin in Acute Withdrawal to Opioids

Poster Abstract: Synthetic opioids are the leading cause of overdose deaths in the United States, and there is a desperate need to find suitable molecular targets for treating opioid use disorder. Originally known for its role in GI physiology, cholecystokinin (CCK) is the most abundant neuroregulatory peptide in the brain. Brain regions that express CCK are known to oppose the rewarding and analgesic effect of opioids, however, the role of CCK circuitry during acute withdrawal from opioids remains unclear. The aim of this study is to determine the role of neural circuitry expressing CCK in a mouse model of naloxone-precipitated withdrawal. Behaviors associated with acute withdrawals to morphine will be assessed and compared to animals that received a control intraperitoneal injection of saline. Neural activity will be measured using immunohistochemistry for c-Fos, a marker for neural activity, in brain regions expressing CCK. We hypothesize that chronic opioid administration causes increased neural activity in both presynaptic and postsynaptic regions of CCK neural circuits after naloxone precipitated withdrawal. The expected learning outcomes for this project are to gain an understanding of the pathophysiological mechanisms underlying opioid use disorder as well as neural anatomy and to gain technical skills in animal behavior and immunohistochemistry.

Acknowledgements: National Institute on Drug Abuse and the MUSC Department of Neuroscience

Authors/Presenters: Philip A. Newman '23 (Pictured Top) and John A. Shirley '23 (Pictured Bottom)

Faculty Mentors: Dr. Patrice Linette Capers and Dr. Kristy Johnson

Title: Optimization of Cortisol Extraction (Homogenization v. No Homogenization and Most Effective Bead Types)

Poster Abstract: Cortisol is a steroid hormone that aids in blood glucose regulation and sympathetic response during times of high stress. While transient elevations of cortisol in the blood have been studied extensively, it has only recently been shown that cortisol deposited in growing hair is an accurate reflection of a systemic concentration over an extended period. This has led researchers to develop protocols for hair cortisol extraction that vary in the steps and materials used to grind hair samples and whether homogenization steps are necessary. The aim of this study is to evaluate hair cortisol extraction methods with and without homogenization using various beads (Zirconium, Silica (Glass), or Stainless Steel) to analyze hair samples from a single individual. We placed 5 mg of hair samples into pre-filled tubes with the respective beads. The homogenizer was then used at different time intervals to break down the hair sample. This sample was later analyzed using the Cortisol ELISA kit. In our preliminary results, we found that using zirconium beads for 6 intervals provided the greatest yield of cortisol extract. The results from this study will provide a more effective procedure for our next research aim, where we will be collecting data from various classes at our institution for comparison.

Acknowledgements: Citadel SURE (Summer Undergraduate Research Experience)

CHEMISTRY

Author/Presenter: Sarah Fink '24

Faculty Mentor: Dr. Thaddeus Le-Vasicek

Title: Desorption of Immobilized Catalysts

Poster Abstract: Catalysts increase the rate of chemical reactions, and are widely used for industrial scale production of materials. However, catalysts impart a significant cost to the production cycle, which can inhibit their utilization in specific industrial sectors. Catalysts can be immobilized to supports, which facilitates their recovery and reuse. Reusing catalysts for multiple cycles lowers the economic impact of the catalyst. In this work, catalysts were immobilized to magnetic nanoparticles by nonspecific adsorption and covalent attachment, the two most common immobilization methods. The immobilized catalysts were subjected to harsh conditions and the detached catalyst quantified so a comparison could be made between the two different immobilization methods. It is imperative that catalyst remain immobilized, facilitating their recovery, during use so that the catalysts can be used for multiple production cycles.

Acknowledgements: The Citadel Foundation

Author/Presenter: Gavin Coulter '25

Faculty Mentor: Dr. Thaddeus Le-Vasicek

Title: Immobilized catalyst performance: comparison of adsorption and covalent attachment

Poster Abstract: There is a growing urgency for increased production of advanced biofuels; fuels derived for inedible biomass which produce 50% fewer emissions compared to fossil fuels. Cellulosic ethanol is an advanced biofuel which can be produced from locally sourced inedible agricultural/industrial waste. However, converting the agricultural/industrial waste into ethanol requires the use of a catalyst, cellulase, which accounts for ~25% of the production cost of cellulosic ethanol. The cellulase can be immobilized to solid supports, which allows for the facile recovery and reuse of the catalyst. Cellulase which can be recovered and reused will lower the production cost of cellulosic ethanol and promote production of a locally sourced liquid energy which produces reduced emission. In this work, cellulase was immobilized to magnetic nanoparticles by two common immobilization methods: adsorption and covalent attachment. The performance of the immobilized catalysts were assessed and compared.

Acknowledgements: The Citadel Foundation and the SURE program

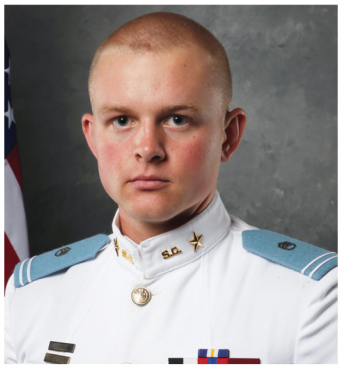
Author/Presenter: Corbin Snavely ’23

Faculty Mentor: Dr. Thaddeus Le-Vasicek

Title: Validation of a protein quantification assay in harsh solutions

Poster Abstract: Every assay must be validated prior to use. The bicinchoninic acid (BCA) assay is a sensitive method used to quantify protein in dilute, ~ µg/mL, samples. The BCA assay relies on the amide bond in proteins to reduce Cu^{2+} to Cu^{1+} which subsequently reacts with BCA to produce a purple colored product. However, the reduction of Cu^{2+} and formation of the colorimetric product are affected by the ionic composition of the matrix. Therefore key analysis considerations, such as the limit of detection, sensitivity, and linear range, must be determined for each unique matrix. In this work, the performance of the BCA assay was assessed in the following solutions: 40 mM acetate pH 5, 40 mM phosphate pH 7.4, 5 M NaCl, and 6 M guanidine.

Acknowledgements: The Citadel Foundation



Author/Presenter: S. Evan Stravolo ’23

Faculty Mentor: Dr. Megan Moyer

Title: Targeted Drug Delivery Using ZIF-8 MOFs

Poster Abstract: Metal organic frameworks (MOFs) are a unique class of crystalline porous materials composed of positively charged metal ions connected by organic linker molecules. The coordination of the ions and organic linkers creates a large repeating cage-like structure that results in a very high internal surface area. MOFs have been reported as drug delivery vehicles that control the release of the drug to specific sites based on the pH of the cellular environment. Doxorubicin (Dox) is a type of chemotherapy drug called an anthracycline. Its current method of administration is intravenous and is classified as a vesicant, meaning that it causes rashes and inflammation around the site of injection. MOFs can be administered in such a manner that target delivery could reduce circulation of the cytotoxic chemical in the bloodstream and prevent an epidermal reaction. Utilizing the organic dye rhodamine B similar in structure (size, shape) and chemical properties (hydrophobicity, polarity) to Dox, we can investigate the optimal loading synthesis procedures and further utilize Dox in release studies to characterize its delivery timeframe.

Author/Presenter: Nicholas R. Herzler '23

Faculty Mentor: Dr. Blakely Adair-Hudson

Title: MoS_2 layered membranes to extract metals from water

Poster Abstract: Lack of access to potable water is a problem in many places, because local sources are contaminated with hazardous materials such as lead. While many methods of lead removal have been developed, MoS2 nanosheets have garnered a lot of attention recently. The reason why is because MoS2 nanosheets have shown the ability to bind both organic and inorganic hazards, giving it a high level of flexibility in its use. The technique that is used to create the nanosheets is to mix aqueous solutions of l-cysteine and sodium molybdate dihydrate and adjust the pH to 2. The solution is heated in a hydrothermal reactor for 24 hours. After the solution cools it can settle over a membrane and create layers. The benefits of this particular method are that there is a lot of opportunity to change aspects of the procedure. The original method layered MOS2 sheets onto PVDF membranes which were used to remove organic matter. In this experiment we used nylon membranes and tested removal of metals. Future testing of this method can be used to determine if the nanosheets being formed can be used for point of use applications at a house.

Acknowledgements: The Citadel Foundation and Dr. Megan Moyer

Author/Presenter: Angela ’24

Faculty Mentor: Dr. Thaddeus Le-Vasicek

Title: Modified magnetic nanoparticle recovery

Poster Abstract: The magnetic recovery/separation of magnetic particles is a key feature of magnetic nanoparticles. Magnetic nanoparticles are utilized by researchers and medical practitioners as the particles possess a high surface area to volume ratio and high magnetic susceptibilities. Magnetic nanoparticles are typically modified with ligands to introduce new functionalities to the nanoparticles. However, the magnetic susceptibility of the nanoparticles decreases with modifications. A reduced magnetic susceptibility weakens the nanoparticles ability to be magnetically stimulated and recovered. In this work, magnetic nanoparticles were functionalized with varying degrees/types of ligands, and the magnetic recovery of the particles quantified.

Acknowledgements: The Citadel Foundation

Author/Presenter: Evans Banks ’24

Faculty Mentor: Dr. Megan Moyer

Title: Development of a Corn-Fiber Filter for Cleaner Water

Poster Abstract: Contamination of drinking water sources is an issue that must be addressed using readily accessible materials. Many strategies have been employed to remove a variety of pollutants, including pharmaceuticals, organics, and heavy metals. Often, however, complex systems are involved or expensive filters are employed, which may limit access to clean drinking water for many people. Corn fiber, a waste material of the starch and gluten extraction process, can be used to synthesize carbon filter materials without added complexity or high cost. The absorption capabilities, light weight, and low-cost advantages of corn fiber were used to create an effective and environmentally beneficial filter for both water soluble organic and inorganic pollutants. Corn fiber waste materials were hydrothermally carbonized via a relatively low temperature and scalable synthesis method to create a filter with an affinity for water soluble pollutants. In concentrations similar to pollution levels in public water systems, the filter effectively removed over 676 times the tolerance level of Rhodamine B, a model organic pollutant, and over 43 times the tolerance level of lead.

Acknowledgements: The Citadel Climate Center

CYBER AND COMPUTER SCIENCES

Author/Presenter: Justin Hedges '23

Faculty Mentor: Dr. Prosenjit Chatterjee

Title: Network of Drones with Facial Recognition Capabilities

Poster Abstract: Drones are used in commercial and private most often by individuals. Combining them into a larger network allows their mobility and wide range of capabilities to be spread throughout a large area. Utilizing this mobility and potential for facial recognition purposes opens up potential security applications and safety capabilities not possible by the use of a traditional CCTV system or even human security capabilities. By training a network of drones to find individuals within a given area, this individual could be found quickly and efficiently with minimal danger to both the individual being sought and the drones that are seeking. This application can also be portable and brought to venues that traditional security would not allow for. The research presented here shows the low barrier to entry into creating an effective, mobile, and network automated security system.

Acknowledgements: The Citadel Near Center for Climate Studies

Authors and Presenters: Slateon Frederick '23 (Pictured Top) and George Honiotes '24 (Pictured Bottom)

Faculty Mentor: Dr. Shankar Banik

Title: Context-Aware Access Control for Internet of Things (IoT) Networks

Poster Abstract: In an increasingly interconnected world, the need for security in the realm of Internet of Things (IoT) devices (i.e. Alexa, Ring, smart-bulbs, Echo Dot) becomes increasingly prevalent. Due to the availability of countless types of IoT devices, it is hard to standardize any form of security that can readily apply to any or all IoT networks. Traditional access control models pose a limitation on IoT Networks when the context of the situations demands an adaptive and dynamic access control model. In our research, we propose a framework for Context-Aware Access Control for securing IoT Networks. We use a popular automation software known as HomeAssistant for implementing our proposed framework. Our solution consists of three steps. First HomeAssistant will collect information from the connected IoT devices and determine the context of the situation based on the ruleset that are defined for that IoT Network. Next it will verify the user and define the access control for the user based on the derived context. Finally, it will enforce the defined access control for the user on the IoT network. We have tested our proposed framework for a home IoT network in our research lab for different case scenarios.

Acknowledgements: This project is funded by NSA NCAE-C Research Grant H98230-20-1-0367. The Citadel collaborated with University of South Carolina on this research project.

Author/Presenter: Dalton Hazelwood '23

Faculty Mentor: Dr. Deepti Joshi

Title: Discovering Influencing Factors for Social Unrest using Clustering

Poster Abstract: Social unrest is a multifaceted phenomenon that is driven by a complex set of factors within a region. For example, if the general public has grievances against the local government official, there is a higher likelihood for some type of protest event to occur within the region. However, most of the datasets that contain such information from sources such as World Bank or USAID, are at country level. Social unrest is more likely to be influenced by local factors. Thus, we have devised a framework called SCEIGE to capture the relevant Socio-demographic, Cultural, Environmental, Infrastructure, Geographic and Economic factors that influence different types of unrest events within a region. To get localized information, we have partnered with the organization Fraym Inc. and obtained rasters for India on features such as proportion of females employed within a 1 squared-km region. In this research, we present our results of transforming the raster layers to attributes for each subdistrict within India (n=5966). Next, we apply partitional and hierarchical clustering algorithms in order to identify the regions that more similar to each other based on the various SCEIGE factors. Our future work will correlate these clusters to unrest events to discover the hidden relationships.

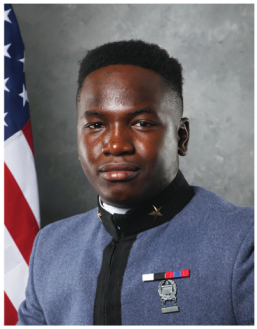
Authors: Hannah E. Collee ’23 (Pictured Top Left), Benjamin Prins ’23 (Pictured Top Right), Addy Liu ’23 (Pictured Bottom Left), Aaron Suttles ’23 (Picture Unavailable)

Presenter: Hannah E. Collee ’23

Faculty Mentor:
Dr. Deepti Joshi

Title: Detecting Climate-related Events from Social Media using NLP and Image Classification

Poster Abstract: Global warming and rising sea level have increased the frequency and intensity of extreme events (e.g. storm surges, and flash floods) and chronic climatic hazards (e.g. frequent tidal flooding) in coastal regions. Recent advancements in big data analytics has created new opportunities for near real-time detection of the acute impacts of natural disasters (e.g. bridge collapse due to a hurricane). Effective disaster response and adaptation planning requires (i) quick, and low-cost detection of acute and chronic climatic events; and ii) effective assessment of the physical, social, and economic impacts of each event. To address this, we are employing text mining, image processing, and deep learning techniques to detect both the acute and chronic climatic events in a coastal region through Twitter Datasets for 2019 during the time Hurricane Dorian impacted the Carolinas. We are developing a deep learning model to detect and classify images uploaded by users that show a flooded street for example. In addition, we are developing text mining approaches to filter out the tweets that mention a climate related event such as a broken tree due to high winds. The tweets are geocoded to pin-point the locations where help is needed, and resources need to be diverted.



Authors: Sharize Roper '23 (Pictured Top Left), Brian Mutua '23 (Pictured Top Right), Sebastian Klincewicz '23 (Pictured Bottom Left)

Presenter: Sharize Roper '23

Faculty Mentors: Dr. Shankar Banik and Dr. Deepti Joshi

Title: Creating User Email DNA to Detect Spear Phishing Attacks

Poster Abstract: Social Engineering attacks are getting more common by the day. Spear phishing is a social engineering attack where the attacker poses as a legitimate entity and extracts private information from the individual being attacked. Current tools detect phishing emails by scanning for embedded links or attachments. However, spear attacks where the emails don't contain any links or attachments are not marked as phishing emails. In this work, we are creating a methodology to develop a user's Email-DNA. This Email-DNA will uniquely identify each user based on their writing features, styles, habits and composition. We are applying both natural language processing (NLP) methods as well as machine learning algorithms such as decision trees and neural networks to create an Email-DNA for each user in the database. Using NLP methods, we have extracted user features such as the most commonly used words by the user, average email length, salutations commonly used, the time window within which the user commonly emails, etc. We are currently using the Eron email dataset to develop our methodology. Our next goal will be to test our approach on a real dataset and evaluate the effectiveness of our proposed Email-DNA.

HEALTH AND HUMAN PERFORMANCE

Author/Presenter: William Templeton '23

Faculty Mentor: Dr. Sarah A. Imam

Title: The Functional Limitations of Arthritis and the Impact on the Economy

Poster Abstract: Arthritis is defined as the inflammation or swelling of one or more joints. There are many types of arthritis, the most common being osteoarthritis and rheumatoid arthritis. Osteoarthritis is the "wear and tear" that happens when joints are overused. Rheumatoid arthritis is an autoimmune disease where the immune system attacks the joints. The aim of this research study is to examine the prevalence of debilitating arthritis, comparing South Carolina to the United States, and to further investigate the impact this has on the economy. Data from the National Health and Nutrition Examination Survey (NHANES) and Centers for Disease Control and Prevention (CDC) were analyzed to examine the prevalence of arthritis-attributable work limitations among working-age (18 to 64 years) adults with arthritis. South Carolina has one of the highest rates of debilitating arthritis, once an individual is diagnosed with arthritis. 48.64% of the SC population have arthritis-attributable work limitations, compared to the national rate of 42.24%. Arthritis has a profound economic, personal, and societal impact in the United States. The total national arthritis-attributable medical care costs and earnings losses among adults with arthritis were $303.5 billion or 1% of the US Gross Domestic Product (GDP).

Author/Presenter: Caleb Raab '23

Faculty Mentors: Dr. Dena Garner and Dr. Kimbo Yee

Title: The effects of mouthpiece use on respiratory outcomes during a maximal exercise test

Poster Abstract: Recently, studies have focused on the use of an oral appliance to improve anaerobic and aerobic physical performance. Within our laboratory we have sought to determine if these improvements are physiological by measuring respiratory patterns during steady state exercise. The purpose of this pilot study was to assess the effects of a lower oral appliance during a maximal exercise protocol. Data from six male subjects between the ages of 18-21 was used for this pilot study. Subjects were fitted with a lower mouthpiece, which has two bite pads that shift the mandible forward and a tongue bar to encourage the subjects to place their tongue on the floor of their mouth. Using a crossover design, subjects completed two trials of a maximal effort treadmill test on two separate days with a minimum of five days between tests. Subjects were randomly assigned the use of the mouthpiece or no mouthpiece control condition during the maximal tests. There were no significant differences in respiratory patterns between conditions across overall time of the time; however, the first five minutes of the testing provided interesting findings as it differences in key respiratory variables. Additionally, of importance is that the use of the mouthpiece did not impair the performance in any of the subjects except for one subject. Further research is warranted to determine if any of these trends continue.

Author/Presenter: Benjamin Johnson '23

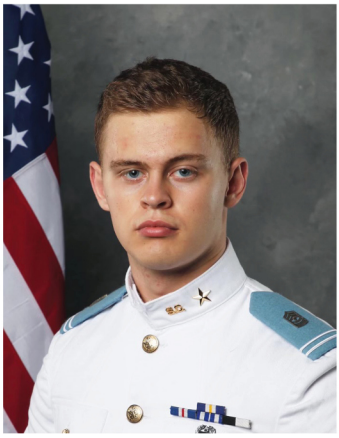
Faculty Mentor: Dr. Sarah A. Imam

Title: The Impact of Mobility and other disabilities on Annual Dental Examinations

Poster Abstract: There are four main classifications of disability: cognitive, hearing, vision, and mobility. Mobility disability is defined as "serious difficulty walking or climbing stairs." This study aims to compare the impact all four disabilities have on annual dental visits. Data was collected from the Centers for Disease Control and Prevention and the DHDS, 2020. Regional data was collected, as defined by the U.S Department of Health & Human Services (HHS.) Statistical analysis was performed to quantify the association between annual dental visits for each disability category, compared to those with no disability.

48.5% with a mobility disability did not visit the dentist annually, the highest rate among all the disability categories. In the South, this % further increases to 53.6%. This is significantly higher than the 29.4% in the national, non-disabled population. All disability categories did not visit the dentist at a much higher rate when compared to the non-disabled population: cognitive disability 47.1%, hearing disability 43.6% and vision disability 46.9%.

These results indicate that those with mobility disabilities see the dentist for annual check-ups the least when compared to other disabilities. In comparison to the non-disabled population, 70% more do not have annual dental check-ups.



Author/Presenter: Jesse Young '23

Faculty Mentor: Dr. Sarah A. Imam

Title: Suicide - A Longitudinal Study Investigating the Rate and Cause of Suicide among Young Adults

Poster Abstract: This study examines suicide rates in Southeastern United States for males and females ages 15-24 over a period of twenty years and to identify key factors that play a role in the rate of suicide. Data was obtained from the Centers of Disease Control. Trends indicate an increase in suicide rates over time both males and females. This is true for both Northeastern and Southeastern areas, however, the South has a greater rise in the rate of suicide. The average suicide rate increased 20% per year per 100K females in the South (r2=90%). The average suicide rate for males increased 31% per year per 100K males (r2 = 62%). Male suicide rates in the South indicated a much higher rate of change. Suicide rates increased nearly 100% during the most recent eight year period (r2=96%). When being compared to the Northeast, which had an increase of only 14% per year (r2=40.5%) in males and a 9.6% increase in Females per year (r2=67%). Suicide is preventable and understanding the factors that have caused a rise in the rate of suicide may assist us better with interventions. Everyone has a role in assisting those that may be contemplating suicide.

Authors/Presenters: Sarah Quinn '23 (Pictured Top) and Suzuka Yosue '23 (Pictured Bottom)

Faculty Mentors: Dr. Alex Gang & Dr. L.J. Lee

Title: The Formation of Social Capital among Cadet-Athletes at a Senior Military College

Poster Abstract: The different demographic of student social networks, specifically student and student-athlete, leads to various types and strengths of bonds amongst students and their peers. This research aims to investigate the social interaction of cadet-athletes within the two social settings: primary (i.e., battalion) and secondary (i.e., athletic team) settings and determine if bonds formed are tighter amongst themselves or outside their primary social network, and what kind of difference (if any) occurs in the social capital development of the two contrasting settings. Ultimately, it will be investigated how cadet-athletes' social interaction within the secondary setting has positive/negative influences on the overall generation of social capital. To explicate the purpose of this research, a qualitative interview with the members of women's soccer team will be conducted. This research will enhance our understanding on the role of sport (and horizontal network formed through it) that will influence social capital development in a related, yet contrasting environment, confined in the same spatial context, which resembles much of our contemporary social life in our primary and secondary social settings (e.g., household, work).

Author/Presenter: Tatiana Corso '23

Faculty Mentors: Dr. Alex Gang & Dr. LJ Lee

Title: Satisfaction with Life, Sleep Quality and Perceived Stress: Analysis of the NCAA D1 International Student-Athletes

Poster Abstract: Since the number of international student-athletes competing in the NCAA is constantly growing (from 8,945 in 2001 to 22,985 in 2020), it is important to understand the level of overall satisfaction and quality of life for this special group. Several factors play key roles that influencing student life satisfaction. Quality and quantity of sleep are without doubt fundamental in student-athlete's life since they are an important part of recovery and athletic performance. Moreover, mental well-being is another vital component for student-athletes as they have to not only face various stressors in the sport environment but also need to deal with everyday life situations. The purpose of this study is to examine the level of satisfaction (academic and athletic) and quality of life among student-athletes who participate in the NCAA by using the two critical factors (i.e., sleep quality and mental well-being) to life satisfaction. The findings will not only give coaches and administrators a better understanding of student-athlete's academic and athletic experience but also provide the key factors leading to an increased level of overall satisfaction.

MATHEMATICAL SCIENCES

Authors/Presenters: Ernest James ’23 (Pictured Top) and William Boyd ’25 (Pictured Bottom)

Faculty Mentor: Dr. Antara Mukherjee

Title: The Good and Bad of Sequences

Poster Abstract: We solved problem 2146 from Math Magazine. The problem consisted of four parts dealing with certain properties of arithmetic sequences with initial term a and common difference d. In particular, the sequence is called good if

$$\sum_{i=0}^{k-1} a + d\,i = \sum_{i=k}^{n-1} a + d\,i$$

while it is bad otherwise. In this poster we discuss different cases of good and bad arithmetic sequences in this sense.

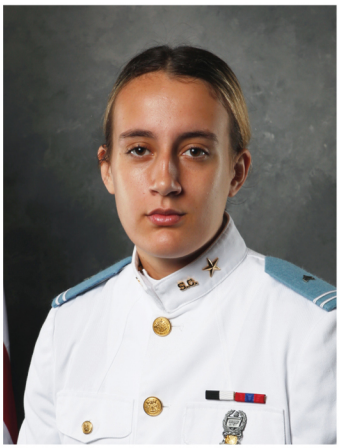
Author/Presenter: Ernest James ’23 (Pictured Top)

Faculty Mentor: Dr. Jeffery Lyons

Title: Application of LRC Circuit Equation

Poster Abstract: We studied the imaginary and distinct real roots cases of the LRC-series circuit equation with no impressed voltage $Lq'' + Rq' + \frac{1}{C}q = 0$

where $q(t)$ is the charge on the capacitor at the time (t) and we have boundary conditions $q(t_1) = q_1,\ q(t_2) = q_2$. This differential equation results from Kirchhoff’s Law and is studied in many engineering and differential equations courses. By applying Peano’s Analog, we found that derivatives to a solution of the Boundary Value Problem with respect to t_1, t_2, q_1, q_2 solve the associated variational equation with interesting boundary conditions as stated in the theorem. In the future, we hope to further study these derivatives and learn more about the relationships between inductance, resistance, capacitance, and the boundary time and charge values.



Author/Presenter: Sadie Gomez '25

Faculty Mentors: Dr. Breeanne Baker-Swart and Dr. Antara Mukherjee

Title: Prime Progressions

Poster Abstract: The objective of this research is to find the number of primes of the form :

$ap_n + b$ where a, b are positive integers and p_n are prime numbers.

This an unsolved problem posed in the article Thirty-Six Unsolved Problems in Number Theory by Dr. Florentin Smarandache. We chose to explore the specific cases when a is 3 and b is a multiple of 7 since they generate more primes than the other cases we looked at.

Author/Presenter: Megan Karcher '26

Faculty Mentors: Dr. Antara Mukherjee & Dr. Breeanne Swart

Title: A Double Fibonacciesque Triangle

Poster Abstract: This is triangle of numbers, very similar to the Fibonacci Triangle and the Pascal triangle. In particular, second diagonal from the left is made up of the Fibonacci numbers. This triangle was given as a OEIS Challenge (P419) from "The Playground" in the Math Horizons magazine as an open question. In this poster we discuss four different properties of this triangle including a Hockey Stick like property and several diagonal properties.

PHYSICS

Authors/Presenters: Jesse Quimby ’23 (Pictured Top) and Kohl Hammer ’23 (Pictured Bottom)

Faculty Mentor: Dr. Kaelyn Leake

Title: Investigating the acoustic control of particles moving in a fluid

Poster Abstract: The goal of this project is to understand how sound waves could be used to alter the trajectory of an object moving in a fluid. Controlling the path of an object with acoustics has several potential applications, for example, in biomedical sciences and in the defense industry. A set of experiments to investigate the role of sounds waves incident on a spherical projectile moving through a fluid are presented. To determine the effect of the vibrations, the impact force of the object against a surface is experimentally collected after the projectile passes through the liquid and strikes a force sensor. The relationship between the liquid characteristics (density and viscosity) and the effect on the impact force is discussed.

NURSING

Author/Presenter: Arista N. Couture '23

Faculty Mentor: Dr. Smith

Title: Chaplain Utilization in Nursing Simulation

Poster Abstract: During a simulation, 15 senior nursing students had the opportunity to consult a chaplain during a stressful patient encounter. The students and chaplains were asked to complete anonymous surveys that may give a new understanding of the benefits and barriers of interprofessional collaboration during a nursing simulation in the Swain Department of Nursing lab. Data was analyzed by 3 faculty members and one student utilizing Colaizzi's method for data analysis, survey data was extracted, organized into categories, and analyzed to gain a new understanding. The findings from this qualitative study will inform future interprofessional and holistic health simulations. The conclusion and expected learning outcomes of this study provided nursing students with a more in-depth understanding of the chaplain resources and how to better prepare use of this resource in their future nursing careers. The results of this study revealed the following themes: Chaplain Role, Holistic, and Simulation Feedback.

Acknowledgements: Additional Mentors - Dr. Bukay & Mrs. Couture

DEGREE PROGRAM HIGHLIGHTS

The Department of Mathematical Sciences is now offering a new concentration in **Data Analytics within the BS in Mathematics Degree.** This program prepares graduates for high-demand professions that require skills in statistical modeling and decision-making based on the processing of massive datasets.

The Department of Chemistry offers two new concentrations for the **BA Chemistry: Clinical Chemistry and Environmental Chemistry.** These programs prepare graduates for cutting-edge careers in biotech, pharma, hospitals and healthcare facilities, manufacturing and commercial laboratories, and state and Federal government regulatory agencies.

Our rapidly growing **BS in Cyber Operations** has been designed based on the Academic Requirements for The National Security Agency Center of Academic Excellence in Cyber Operations is a highly-technical degree that prepares graduates for high-paying careers within industry, government, and military domains involving the security of cyber systems, the investigation of different types of attacks and incidents in cyber systems, and both defensive and offensive maneuvers in cyber warfare.

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