School of Natural Sciences and Mathematics Pathways and Undergraduate Research Presentations

Friday, June 28, 2024

9:00 a.m.

Iowa Room

Dr. Verlie A. Tisdale, Acting Dean

Program

Opening/Welcome.....Dr. Verlie A. Tisdale
Vice Provost for Academic Programs
Acting Dean, School of Natural Sciences and Mathematics

9:15 a.m.....Brianna Stafford
Zion Ratchford
Madison Stafford
Shanna Skelton

9:30 a.m.....Amrinder Singh

9:45 a.m.....Rania Jones
Shelby Thomas

10:00 a.m..... Nyasia Argrow
Lystasha Kershaw
Shi'Niya Sims
Erin Thomas

10:15 a.m..... Janiya Burton-Allen

10:30 a.m.....A'nnyya Bryant

10:45 a.m.....Verneda Ritter

11:00 a.m.....Ian Adams

11:15 a.m.....Chibuikem Ikwechegh

11:30 a.m. – 1:00 p.m.....Lunch(on your own,i.e. dining hall)

1:15 p.m.....Chaniya Higgins

1:30 p.m.....Bimal Itani

1:45 p.m.....Jamya Kennedy

2:00 p.m.....Closing Remarks

ABSTRACTS

Brain Stroke Prediction Using Machine Learning

Researcher: Ian Adams

Research Mentor: Dr. Shrikant Pawar

A stroke is a cerebrovascular incident that occurs when the blood supply to part of the brain is interrupted or reduced, preventing brain tissue from getting enough oxygen and nutrients causing brain cells to die within minutes. According to the World Health Organization, strokes are the second leading cause of death globally, just behind ischemic heart disease. Strokes account for approximately 11% of all deaths worldwide, underscoring the critical importance of awareness, prevention, and timely treatment of this medical condition. They not only contribute significantly to mortality rates but also lead to severe disability. Our goal is to determine if the patient is at risk of having a stroke using the CT/MRI scan of a patient's brain. This information is crucial because it allows for early intervention, which can significantly improve outcomes. Early detection can lead to prompt treatment, potentially preventing the stroke or minimizing its severity, thereby reducing the risk of long-term disability and improving the patient's quality of life. Our solution involves training an AI model using Convolutional Neural Networks (CNN) to predict the risk of brain stroke in patients from their CT/MRI scans. CNNs are particularly effective in image analysis due to their ability to automatically learn and detect patterns and features within visual data. By leveraging a large dataset of brain scans, our model will be trained to recognize the subtle indicators of stroke risk. This approach aims to provide accurate and early predictions, enabling timely medical interventions that can prevent strokes or minimize their severity, ultimately reducing healthcare costs and improving long-term health outcomes for patients.

Isolation of Antibiotic-Producing Bacteria from Congaree Bluffs Heritage Preserve

Researchers: Nyasia Argrow, Lystasha Kershaw, Shi'Niya Sims, and Erin Thomas

Research Mentor: Dr. Randall H. Harris

Antibiotics are used to treat and prevent bacterial infections by killing the bacteria or preventing them from growing and spreading. Bacteria have become increasingly resistant to antibiotics. The World Health Organization estimates that by 2050, antibacterial drug-resistant infections will kill 10 million people internationally every year. This study aimed to isolate and identify antibiotic-producing bacteria from Congaree Bluffs Heritage Preserve soil samples. Soil samples were diluted with ratios between 10-1 and 10-5 and plated on various media. Bacteria that grew from the soil samples were then co-cultured with *Micrococcus luteus* to examine antibiotic production. After the the *M. luteus* screening, the subset of antibiotic-producing bacteria was co-culture with *Enterococcus faecalis, Staphylococcus aureus, Klebsiella pneuomoniae, Acinetobacter baumannii, Pseudomonas aeruginosa,* and *Enterobacter species* (ESKAPE pathogens). Seven bacteria produced zones of inhibition against *S. aureus* or *E. faecalis* on Mueller Hinton or Luria Bertani media. A PCR and agarose gel electrophoresis of the 16S rRNA gene was conducted using colonies from the seven bacteria. Despite efforts to amplify the 16S rRNA gene, the PCR did not

give conclusive results. As a result, genus/species identification of antibiotic producing bacteria using the 16S rRNA gene was not performed.

Nicotine Solution Increases and Decreases the Heart Rate of Different Life Stages of *Daphnia Magna*

Researcher: A'nnyya Bryant

Research Mentor: Dr. Steffani Driggins

Nicotine is a stimulant that increases the release of dopamine. Dopamine is a neurotransmitter that affects mood, pain perception, and memory. The release of dopamine causes an increase in motivation and alertness. Studies with humans have proven that nicotine can increase a person's heart rate. The purpose of the research that was conducted was to see the effects of nicotine on the heart rate of different life stages of *Daphnia magna* which is an invertebrate. Due to the fact that the body of *Daphnia magna* is transparent, the heart of the organism is easy to observe. During the experiment, the *Daphnias* were removed from their tank and individually placed onto a concave microscopic slide. The heartbeats were then counted before the addition of the nicotine solution. The heart rate was counted for one minute and recorded. Next, 4ul of the nicotine solution was placed on top of the *Daphnia*. A total of 7 minutes elapsed before the heartrate was counted again. The data from the experiments showed that the pregnant *Daphnia* had an increased heart rate after the nicotine was added. The data from the adult *Daphnia* that were not pregnant showed that the heart rate slightly increased. The data also indicated that the heart rate of the juvenile *Daphnia* decreased. Overall, the data indicated that the nicotine solution had a different effect on the heart rate of the *Daphnias* based on their stage of life.

The Effects of a Nicotine Solution on *Daphnia Magna*

Researcher: JaNiya Burton-Allen

Research Mentor: Dr. Steffani Driggins

Daphnia magana, commonly known as waterfleas, are planktonic crustaceans. These small organisms are part of the Phyllopoda (or Branchiopoda) subclass, characterized by their flattened, leaf-like legs which generate water currents to aid in filtering food particles. *Daphnia* are suspension feeders, primarily consuming algae. *Daphnia* inhabits a wide range of aquatic environments, from large lakes to small temporary pools like rock and vernal pools. They thrive in waters with a pH between 6.5 and 9.5. *Daphnia* are extensively used in research due to their ecological significance and ease of maintenance in laboratory settings. They are pivotal in studies of diel vertical migration, resurrection ecology, host-parasite interactions, community ecology, and climate change. The research study that was conducted investigated the effects of nicotine on *Daphnia magna*. The experiments involved exposing *Daphnia magna* to 6ul of a nicotine solution to observe changes in its' heart rate. Both pregnant and non-pregnant adult *Daphnia magna* were

used in the experiments. The data from the experiments indicated that the heart rates of the pregnant *Daphnia* and non-pregnant *Daphnia* were effected by the nicotine solution.

Classical trajectory to understand chemical reactions in potential energy surface

Researcher: Chaniya Higgins

Research Mentor: Dr. Bijoy Dey

A key tool in the study of chemical reaction dynamics, classical trajectory theory (CTT) provides deep insights into how atoms and molecules behave during chemical reactions. To apply CTT to chemical reactions, this session will examine how computational methods and software tools can be integrated. An in-depth explanation of how to apply the Runge-Kutta method to solve the classical equations of motion is provided. Particle trajectories may be precisely simulated thanks to this potent numerical approach, which is essential for accurate reaction dynamics modeling. We have calculated classical trajectory for a reaction modeled by a four-well potential energy surface, where each well represents reactant or products. Our results were generated with Fortran 90 coding and graphs were generated with gnuplot. The trajectory shows the path reactants take to get to the product state.

Genetic Algorithm for optimizing a function: Application to Chemical problem of structure optimization

Researcher: Chibuikem Ikwechegh

Research Mentor: Dr. Bijoy Dey

Genetic algorithm is a computation tool that is modeled on natural selection of evolutionary of population whereby ech successive generation improve their fittest to survive. This method is used to optimize a mathematical function. My research focused on understanding the genetic algorithm and optimization of a functional called Goldberg function. The code starts with creating a genome sequence of a certain number of individuals, which are basically a combination of binary digits 0 and 1. The decoding is done to determine corresponding parameters that the function depends on and so the value of the function is known. The code that selectively mutate the genome sequence and modify the parameters to find the fittest candidate over subsequent generation – this eventually optimizes the function and return the maximum value of the function, which the goal. We have made the code work and we plan to apply the code to evaluate the structure of chemical molecule in the near future.

Using Artificial Intelligence to Diagnose Brain Tumors: A Neural Network Approach

Researcher: Bimal Itani

Research Mentor: Dr. Shrikant Pawar

This research explores using artificial intelligence to improve the diagnosis of brain tumors through a neural network approach. Specifically, we developed a convolutional neural network (CNN) model based on the VGG-16 architecture to detect and classify brain tumors from MRI scans. By training our model on a large dataset of annotated images and employing data augmentation techniques, we enhanced the model's ability to accurately identify tumors. The model, optimized using the AdamW optimizer, achieved impressive results with a validation accuracy of 90% and a test accuracy of 100%. Our findings indicate that integrating AI tools into medical practices could help radiologists make faster and more accurate diagnoses, ultimately improving patient outcomes. This study, conducted with the support of Claflin University and under the guidance of Dr. Shrikant Pawar, highlights the potential for AI to revolutionize medical diagnostics and pave the way for more personalized and efficient healthcare.

The Prevalence of Biotechnology in Dr.Basgara's Rotation of research and lab

Researcher: Rania Jones

Research Mentor: Dr. Omar Bagasra

When scrutinizing the pivotal role of biotechnology, Dr. Basgara's laboratory has provided an intensive six-week program to underscore its integral contribution across diverse realms of science. Biotechnology combines technology with different biological systems, living organisms, or biological components to innovate or produce diverse products. While at Claflin University, Dr. Basgara's laboratory has offered many opportunities to learn about the processes and analyses involving forensic DNA, the influence of maxiprep on bacteriophages, orchid cloning, neurogenesis, fluorescent microscopy, and drafting a scientific scholarly article in the proper manner. At the Forensic Science Laboratory in Orangeburg, South Carolina, Amanda Webb, a DNA Analyst with the Department of Public Safety, spent two weeks delving into and imparting the understanding of forensic DNA analysis. Ms. Webb explored the techniques of extraction, purification, analyzation of DNA that is retrieved from suspect's biological samples or objects that may retain those biological samples. Ms. Webb also examined analysis procedures such as DNA sequencing, PCR, and STR analysis. Under the supervision of Dr. Basgara's laboratory, Plasmid DNA Maxiprep was a laboratory technique taught for the isolation of bacteriophages and purification involving an ample collection of plasmid DNA that may have been retrieved from the bacteriophage cultures. Another realm of research was orchid cloning, as Dr. Basgara examined the purpose and ways an individual can transfect a cell to manipulate the DNA of the orchid to provide the results of a fluorescent orchid that can glow in the dark. Neurogenesis was another area of research observed during Dr. Basgara's rotation. Neurogenesis is classified as the process of nervous tissue being formed and developed, Dr. Basgara draws the relationship between the definition of neurogenesis to his research as he utilizes two cell lines and studies the manner of

how it controls the body's memory and olfactory systems. Next, Dr. Basgara taught the importance of cell physiology through the exploration of fluorescent microscopy. By learning this essential skill, it has allowed for the comprehension of knowing how to take pictures, observing the differences between nucleus, cytoplasm, and mitochondria visually, as well as the importance that lies behind using mitochondria dye during fluorescent microscopy. With the photos that were taken under Dr. Basgara's supervision, he broadcasted the interactions and movements of tissues, cells, individual cellular structures, and large molecular complexes found in the visualization of a cell. Lastly, the skill of learning how to write a scientific scholarly article correctly was taught through literature reviews and discussions based on the readings given. Dr. Basgara provided comprehensive reading materials to equip students with the necessary insights for conducting independent analyses. Through assigning different tasks, it helped break down the process of writing a scholarly article for his students in a productive manner. He rewarded his students with the opportunity to potentially be published for their contributions by the summer's end.

Strange Meetings: Coliform Microbes and Plastics in Fresh Water

Researcher: Jamya Kennedy

Research Mentor: Ross Johnson

Plastics have become pervasive pollutants in water bodies, posing environmental and health risks globally. Coliform bacteria, specifically Escherichia coli and related species, are indicators of fecal contamination and potential waterborne pathogens. The study aims to isolate and characterize coliform microbes from freshwater samples collected using standardized techniques. The study aims to isolate and characterize coliform microbes from freshwater samples collected using spread plates methods. The microbes derived from the freshwater samples grown overnight with plastics from disposable bottles to determine microbial attachments to plastics. Our preliminary results show the attachment of freshwater isolated microbes on plastics. Studies revealed varying frequencies of coliform presence across sampling locations, highlighting differences in contamination levels and potential health risks associated with water use. This research underscores the importance of regular monitoring of coliform bacteria in freshwater ecosystems to ensure public health, safety, and environmental quality. Future investigations could explore genomic analysis to further elucidate the diversity and ecological roles of coliforms in aquatic environments.

Exposing *Daphnia magna* to as Solution of Nicotine

Researcher: Verneda Ritter

Research Mentor: Dr. Steffani Driggins

Daphnia magna are small freshwater crustaceans that are commonly known as water fleas. Water fleas are 2-5mm long with carapace enclosed bodies, two sets of antennae, six thoracic appendages, large claws, and one compound eye. *Daphnias* consist of males and females. They reproduce sexually and asexually. Depending on the environmental conditions, *Daphnias* can live for 40 days

at 25°C and 56 days at 20°C. The current research that was conducted involved exposing the *Daphnia* to a certain concentration of nicotine solution to observe the effects on their heart rate. The *Daphnia* were either pregnant adult females, non-pregnant adult females, or juveniles. The *Daphnia* were removed from the tank and placed on a concave microscope slide. The heart rates of the *Daphnias* were counted and recorded initially using a stereomicroscope. Their heart rates were then counted and recorded after the *Daphnias* were exposed to 2ml of the stock solution for 7 minutes. The results of the experiments showed that the *Daphnia's* heart rates increased after being exposed to the nicotine solution.

Automating Hemorrhage Detection: A CNN Approach

Researcher: Amrinder Singh

Research Mentor: Dr. Shrikant Pawar

Brain hemorrhages are a critical medical emergency, contributing to a significant number of stroke-related deaths worldwide. Timely and accurate diagnosis is crucial but often hindered by the complexity and urgency of the situation. Our research aims to develop an advanced AI model to automatically detect and classify intracranial hemorrhages from CT scans. Leveraging a convolutional neural network (CNN) trained on a large, annotated dataset of medical images, our model is designed to identify various hemorrhage subtypes with high accuracy and robustness. We trained our model using 750k CT scans and optimized its performance through image preprocessing, dataset augmentation, and fine-tuning of the CNN architecture. Experimentation with various optimizers revealed AdamW to be optimal, achieving a test accuracy of 99%, validation accuracy of 100%, and loss of 0.59.

This study, supported by the Department of Computer Science within the School of Natural Sciences and Mathematics at Claflin University and under the expert guidance of Dr. Shrikant Pawar, demonstrates the transformative potential of integrating AI into healthcare systems. Our findings highlight advancements in medical research, education, and clinical practice, promising to significantly enhance patient care and outcomes.

Genetic Diversity Planted vs Natural

Researchers: Brianna Stafford, Zion Ratchford, Madison Stafford, Shanna Skelton

Research Mentor: Dr. Daniel Koenemann

Longleaf Pine (Pinus palustris) is a species of pine native to the southeastern U.S., known for its very long needles. It is adapted to survive fires and provides important habitat for wildlife. European settlement transformed the longleaf pine ecosystem, resulting in less than 3 percent of it remaining. Efforts such as prescribed fires and planting of longleaf pine have been made to help restore the ecosystem. In this project, we aimed to determine which populations display a higher level of genetic diversity: planted or naturally existing longleaf pine.

To answer this question, we conducted fieldwork by visiting the Francis Beidler Forest to collect samples from both native and planted longleaf pines. We extracted DNA from these samples and performed gel electrophoresis. The success of our results varied based on the quality of the extracted DNA from the longleaf pine samples. In addition to our gel electrophoresis results, we obtained Nanodrop results to quantify the amount of DNA we extracted.

In closing, we are currently unable to fully answer our question. Our next steps will include running a PCR test on the longleaf DNA samples.

Pathway to Biotech 2024 Research Project

Researcher: Shelby Thomas

Research Mentor: Dr. Omar Bagasra

Biotechnology focuses on a diverse spectrum of scientific disciplines and techniques to properly understand various biological processes, organisms, and systems to develop solutions to the many societal issues that currently plague us. Over the past 6-weeks I've learned several different techniques and concepts important to the discipline including orchid cloning, maxi prep, Alzheimer's disease, and learning how to properly write a scientific article. From orchid cloning we learned how to successfully perform plant tissue culture. It started with the focus of the importance of distilled water, then we learned medium preparation, pH adjustment using weak HCL or KOH, how to make a plant preservative mixture to eliminate bacterial and fungal contaminates within the culture, then we focused on the importance of isopropyl alcohol, Clorox, and UV light. We moved on to culture vessels and vessel closures, various techniques for sterilization and contamination prevention, seed sowing, replating, and finally how to take care of our developing orchids in a grow room. The maxiprep helped facilitate the isolation, purification, and analysis of bacteriophage genomic DNA. Alzheimer's disease is a progressive neurodegenerative disorder characterized by cognitive decline, memory loss, and behavioral changes, affecting millions worldwide and remains a huge public health issue. Through the focus of Alzheimer disease, we grew cell lines from the memory and olfactory parts of the brain and learned florescent microscopy in hopes to develop a better understanding of the disease. And finally, we've had a major focus on Mad Cow disease and its future potential dangers that it may have on the human population and through extensive research we are developing a scientific article that will be extremely beneficial. As of now, we are only in the beginning of our research and the results from our projects are currently still in progress.