



ALABAMA SCHOOL OF MATHEMATICS AND SCIENCE 2024 SPRING RESEARCH FORUM

The Spring Research Forum is an academic conference presenting the scholarly activities of the ASMS Research Fellows Program.

Schedule of Events

ASMS Dragon Legacy Distinguished Alumni Lecture

Krystal Hardy Allen, c/o 2003
2:15 pm - Auditorium

Paper Presentations

3:00 pm - 4:20 pm

Media Room

- 3:00 pm *Using Artificial Intelligence for Mathematical Studies* - **Rachel Jordan, Anna Watson, Novita Whillock**
3:20 pm *Investigating the Aerodynamics of Proposed Airplane Wing Flaps on the F/A-18* - **Camryn Bedgood**
3:40 pm *Proposing and Simulating a Novel Solar Sail Deployment Mechanism for Nanosatellites* - **Yunseo Ha**
4:00 pm *Characteristics of Solar Wind with a Different Latitude and Heliocentric Distances* - **Devin Booth**
4:30 pm **Alumni/Student Panel**

B208

- 3:00 pm *Callaghan's Community Culture* - **Ivy Foster, Haylie Ledding, Sarah Woodford**
3:20 pm *How Games Make Meaning: Applying Literary Analysis to Interactive Media* - **Sarah Hoke, JaQuacia McClaney**
3:40 pm *A Spectrum of Perception: Exploring Racial Representation and Codification in Disney's Animated Characters* - **Jayden Cooper**
4:00 pm *Economic Mobility of Mobile County* - **Leah Grace Feirman**

B126

- 3:00 pm *Creating Assistive Technology to Help with Panic Attacks* - **Mikalai Barushka, Houston Brown, John Duffy, Spencer Maples**
3:20 pm *Sustainable Mining Through Advanced Borehole Mining and Algal Carbon Sequestration* - **Omolabake Elenitoba-Johnson, Omar Hernandez-Tena, Jonathan Hulcher, Emma Saalwaechter**
3:40 pm *Experimental Fiction* - **Alice Arrington, Breanna Gaillard, Kayleigh Johnson, Emily Tran**
4:00 pm *A Deeper Look Into The Underwater Forest: A Scientific and Political Exploration* - **Wyatt Aiken**

B129

- 3:00 pm *Examining the plausibility of transgenerational epigenetic inheritance of altered stress response in *Daphnia magna* through HSP90 expression* - **Caroline Wiggins**
3:20 pm *The Impact of Ocean Acidification on *Tetraselmis* sp.* - **Chloe Dykes**
3:40 pm *Connecting mitochondrial biogenesis to the salt stress response pathway in *Saccharomyces cerevisiae** - **Katie Beth Smith**
4:00 pm *Effects of Increasing Humidity and Temperature on CO₂ Production and Growth in *Echinacea purpurea** - **Esha Patel**
4:20 pm *Modeling climate change induced schizophrenia through heat exposure and gene expression in *Drosophila melanogaster** - **Serika Patel**

Poster Session

3:00 pm - 4:30 pm
Bedsole Library Hallway



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Abstracts (alphabetical order)

Comparing Dialogue Frequency and Specific Word Frequencies in Realist, Modernist, and Postmodernist American War Novels

Helen M. Byrne, Mary Whittington

The American Civil War marked a turning point in war literature from the romantic epics of the likes of Tolstoy's War and Peace to more nuanced, critical evaluations of war and its aftermath. The Civil War is seen as the first "total war"- a costly war without limitations that took the lives of many civilians and soldiers. Stephen Crane's 1895 classic "The Red Badge of Courage" reflects this new realism. However, the turn of the 20th century saw the rise of nationalism on a global scale along with advanced war technology that changed the landscape of war, leading to modernist depictions of war like Hemingway's "For Whom the Bell Tolls." This essay examines the differences in the literary depictions of war in realist and modernist war novels, particularly relating to perspective and characterization. *Mentor: Mr. Brian Saylor*

Callaghan's Community Culture

Ivy Foster, Haylie Ledding, Sarah Woodford

Callaghan's Irish Social Club is a local restaurant situated in the historic Oakleigh District of Mobile, AL with a rich history spanning many decades. While there are undoubtedly plenty of places to grab a meal in Mobile, Callaghan's has developed a culture that involves a community brought together by more than just a burger. With a background foundation in simple ethnography studies, we set out to understand what sets this restaurant apart from the hundreds of others in the city. We performed research and field work over the course of several months and gathered data from observational studies, local newspapers, and interviews. In this paper, we synthesize the voices of staff, long-time patrons, visiting performers, and other notable names from the Oakleigh area to interpret the core components of the cultural experience that is Callaghan's. *Mentor: Dr. John Hoyle*

Characteristics of Solar Wind with a Different Latitude and Heliocentric Distances

Devin Booth

Turbulence is ubiquitous in solar wind plasma. Turbulence is thought to be responsible for several interesting phenomena in the solar wind plasma, such as the acceleration of the solar wind speed, the heating of the solar corona into millions of Kelvin, the heating of the solar wind, and the scattering of the solar energetic particles. The turbulence characteristics of the solar wind, such as turbulence energy and correlation length, change with increasing distance from the Sun. There are several spacecraft, ranging from being close to the Sun to being far away from the Sun. They measure solar wind plasma every second and provide us with observational information. These spacecraft measurements help us study the turbulent characteristics of solar wind. The project aims to study how the turbulence characteristics of solar wind vary between 1 and 5 astronomical unit (au) with latitude and heliocentric distance. We will also study the relationship between solar wind turbulence with solar wind speed and plasma beta. *Mentor: Dr. Laxman Adhikari, Dr. Durga Paudel*

Connecting mitochondrial biogenesis to the salt stress response pathway in *Saccharomyces cerevisiae*

Katie Beth Smith

From mammals to microbes, organisms are often faced with a wide variety of environmental stressors and trigger numerous stress responses. On the cellular level, this phenomenon is known as the environmental stress response or ESR. Two possibilities from the ESR include the activation of its defense mechanisms or progression in the cell cycle. The choice in one possibility will result in the repression of the other. Little is known about the influences on this decision, but this behavior is often a consequence of the cell's limited energy capacity. Using a yeast model



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(*Saccharomyces cerevisiae*), this study explores the possibility of a range in intensity to impact the responses to high salinity stress, while using pathway connectivity through TORC1 (Target of Rapamycin Complex 1) to imply the connection of mitochondrial biogenesis to this response. To determine their decision, the yeasts were subjected to a range in stress treatments (varying in concentration). Their response choice was analyzed by taking cell counts through microscopy and determining gene expression with PCR (the target genes were HOG1 and PGC1). Both analyses suggest the morphological responses to the stressor in the control and low intensity salt stress groups are due to their increased presence of DNA. *Mentor: Dr. Natalie Ortell*

Creating Assistive Technology to Help with Panic Attacks

Mikalai Barushka, Houston Brown, John Duffy, Spencer Maples

This project is for the MIT Beaver Works CR[EA]TE Challenge, which is a team-based competition in which someone with a disability is aided. During a panic attack, the person can be immobile and noncommunicative, limiting the ways they can communicate to receive help. Our project focuses on a medical alert system for people who suffer from panic disorder, or repetitive panic attacks. This is accomplished through a wristwatch that is connected to the participant's phone by way of Bluetooth. By pressing a button on the watch, the user can show a message for people physically around them and send a preconfigured message to trusted individuals. This project concludes with a high-fidelity prototype that will be tested to gauge its effectiveness in helping the co-designer communicate with those around them and far away. *Mentor: Ms. Deborah Gray*

A Deeper Look Into The Underwater Forest: A Scientific and Political Exploration

Wyatt Aiken

A few miles off the coast of Gulf Shores lies Alabama's Underwater Forest. Submerged tens of thousands of years ago, is an ecological marvel and a unique look into the forests of the past. These remnants of an ancient cypress forest were quickly covered preserved under mud in an anoxic condition until it was exposed by Hurricane Ivan in 2004. After its discovery, the site has seen an influx of research and attention due to its unique condition. There are worries about the safety of the site, however, as it has not yet received federal protection. Due to the lack of protection, there is some worry that scavengers may be able to locate the site and retrieve the wood, undermining its potential in research. Full protection, on the other hand, would provide protection to this site and set precedent for others like it. In our study, we set out to find what scientific potential the Underwater Forest has because of its unique circumstances and what research may be feasible in the future. Through a synthesis of existing research, exploratory interviews with scientists currently involved with the site, and an analysis of the political indications that protection to the site would bring, we explored the scientific and political implications of Alabama's Underwater Forest. *Mentor: Mr. Mark Berte*

Economic Mobility of Mobile County

Leah Grace Feirman

According to the National Association of Counties, "Economic mobility refers to changes in people's economic outcomes or status over a lifetime or across generations." They have identified seven factors that contribute to a county's economic mobility: Financial Security, Housing, Education and Workforce Development, Health, Justice & Public Safety, Community & Neighborhood Development, and Technology & Information Access. This study examines Mobile County, Alabama through these lenses using statistics from the US Census Bureau and the American Community Survey. Mobile has overall exhibited growth in many of these areas. *Mentor: Dr. Karen Palazzini*



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Effects of Increasing Humidity and Temperature on CO₂ Production and Growth in *Echinacea purpurea*

Esha Patel

Anthropogenic climate change continues to increase average temperature globally, and with larger amounts of heat trapped in the atmosphere, water vapor also remains trapped in the atmosphere, thus increasing humidity. This study focuses on the individual and combined effects of increasing humidity and temperature on a plant native to Alabama's current atmospheric conditions, *Echinacea purpurea*. Factors including average CO₂ production (measured using a PASCO CO₂ sensor), number of leaves, stem length, and chlorophyll a content were measured to study the effects of each condition. After conducting this study, in each plant exposed to either projected humidity, projected temperature, or both, decreases were observed in number of leaves and stem length. As temperature and humidity increased, CO₂ production decreased significantly ($p < 0.005$, ANOVA), with the most significant differences observed between the control group and projected humidity and temperature group ($p < 0.005$, Post Hoc Tukey-Kramer Test). Longer exposure to humidity and heat also decreased chlorophyll a production in all groups ($p < 0.005$, T-Test). These results indicate that the combined effects of increasing temperature and humidity may result in more stressed and less productive plants including crops, suggesting more complex issues facing terrestrial plants than just increased temperature. *Mentor: Dr. Natalie Ortell*

An evaluation of the effectiveness of *Tagetes patula* as a potential companion crop to inhibit growth of fungal disease *Alternaria alternata*: the role of allelopathy and secondary metabolites

Conan Lin

Alternaria alternata is a fungal pathogen that infects leaves or stems of numerous plant species and causes postharvest rot of produce. Mass application of fungicides to control diseases like *Alternaria alternata* may pose the risk of water pollution and the development of resistance to fungicides. Therefore, intercropping is one alternative method to conventional treatments that has been proven to reduce crop disease incidence, with allelopathy being a possible mechanism. Marigolds (*Tagetes* spp.) are flowering plants belonging to the family Asteraceae. Organosulfur thiophenes in marigolds, concentrated in roots, exhibit an antagonistic effect against several fungal pathogens. However, this study aims to specifically investigate leaf and stem secondary metabolites of French marigold, *Tagetes patula*, as possible allelochemicals against the in vitro growth of *Alternaria alternata*, which may make *T. patula* a promising companion crop to protect against fungal infection. The experiments investigated the effect of volatile organic compounds exuded from *T. patula* leaves on the growth of *A. alternata* in a closed chamber, as well as the dose-dependence of water and acetone marigold leaf/stem extracts. The results demonstrated that leaf volatiles ($p = 0.267$) and extracts did not significantly inhibit the in vitro growth of *A. alternata*, but the effect of inhibition was overall not negligible due to differences in mycelial quality. *Mentor: Dr Natalie Ortell*

Examining the plausibility of transgenerational epigenetic inheritance of altered stress response in *Daphnia magna* through HSP90 expression

Caroline Wiggins

Stress is not as unharmed as many believe. The idea that stress does not leave permanent damage on the cellular level is proving to be false. Implications of transgenerational epigenetic inheritance of altered stress response plays a large role in preventive medicine and etiology of mental disorders but is not limited to such. This breakthrough new take on inheritance changes the modern meaning of generational stress. Up until 1998 epigenetic inheritance was assumed impossible. Everything changed in 1998 when Dr Cavalli published a study suggesting plausibility of the phenomenon. Since 1998 the field has grown tremendously with subfields emerging such as transgenerational epigenetic inheritance of altered stress response. By examining the effects of heat induced stress on HSP90 expression in *Daphnia magna* the plausibility of transgenerational epigenetic inheritance



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can be determined. A parent generation (n=30, in quadruplicate) was heat stressed for 1 hour at 37C. Samples were returned to optimum temperature and 4 generations were sampled for DNA extraction and HSP90 expression through cDNA analysis. If the stressed lineage shows increased HSP90 expression compared to the control lineage this implies the altered stress response was passed onto unexposed generations suggesting transgenerational inheritance pattern. HSP90 helps organisms return to homeostasis when under stress by altering the steady state of the cells to upregulate transcription factors to create proteins. If the fourth generation is still producing heightened levels of HSP90 then the *D. magna* are still experiencing a perturbation of homeostasis from stress they were never directly exposed to. *Mentor: Dr. Natalie Ortell*

Experimental Fiction

Alice Arrington, Breanna Gaillard, Kayleigh Johnson, Emily Tran

Mid to late twentieth century historical events affected the way post-modernist writers not only perceived the world, but also how they conveyed their experiences. We analyzed three novels from three consecutive decades. The first novel, "In the Labyrinth" by Alain Robbe-Grillet, was written in 1959. It follows a wandering soldier who suffers from Amnesia and PTSD. The second novel was the "Crying Lot of 49," which was written by Thomas Pynchon in 1965. This book follows a woman on a quest for knowledge of her ex-lover's mysterious death. The third novel is called "If on a winter's night a traveler," written by Italo Calvino in 1979. This novel follows a man on a search for the ending of a novel that he cannot seem to find. All three novels share the theme of never discovering the truth. Our project researches this theme in connection with the world that surrounded the authors and influenced their writing styles during the period of which their stories were composed. *Mentor: Mr. Daniel Commander*

Fast and Cheap Synthesis Method for YBCO and BSCCO Based Superconductors

Dori Do, Naria Khristoforova, Aiden Ray, Joseph Sherrod

Superconductors are materials that have zero resistance when electrical current flows through them. Superconducting materials have already seen significant usage in scientific and medical instrumentations; however, these materials can be extremely costly and time-consuming to produce with laboratory periods ranging from 7 to 24 hours. In this study, attempts were made to produce high-quality samples of two room-temperature superconducting materials, YBCO and BSCCO, through a microwave synthesis method using 30-minute heating cycles. This fast-paced synthesis can allow easier inclusion of substituents due to easy oxidation; however, these substituents typically require atmospheric evacuation to be included. Through this study, it is hoped that a novel synthetic method for room-temperature superconductors can be developed. *Mentor: Dr. Matthew Davenport*

A Fossil Cetacean from the Lower Oligocene of Alabama Sheds New Light on the Evolution of Modern Whales

Lindsey Stallworth

During the summer of 2023, the fossilized bones of a large animal were discovered in Monroe County, AL about 300 meters from the eastern bank of the Alabama River. The overlying rock was carefully removed using hand chisels and dental picks until one of the bones and an intact tooth were fully exposed. After consulting with experts in the field and comparing the visible parts of the fossil with historical records of other fossils found in the area, I determined that the bones belonged to an extinct archaeocete whale. After several more weeks of careful excavation, the skull of the animal was removed from the site and taken back to a paleontology lab for further cleaning and study. Back at the lab, I used a pneumatic air scribe and several types of adhesives to continue cleaning and repairing the fossil. Samples of the soil surrounding the fossil were examined using a compound microscope and I discovered the presence of selenite and glauconite crystals. According to data from the Alabama Geological Survey, this confirms that this fossil was from the Red Bluff Clay which is lower Oligocene in age (33.9 million years old). Using cladistic analysis, I was able to determine that this animal is closely related to *Tutcetis* which is a member of the Basilosauridae family. The results of this project indicate that this specimen is



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the first Oligocene archaeocete whale ever discovered in the Gulf Coastal Plain of North America. *Mentors: Dr. Andrew Gentry, Dr. James Parham*

How Games Make Meaning

Sarah Hoke, JaQuacia McClaney

Students in the Video Game Studies research project consulted texts by digital humanities scholars and theorists to learn how video games create meaning in ways distinct from traditional media like fiction, cinema, and television. They applied theories from ludic studies to their own analyses of individual video games. Implementing a cultural studies approach, Sarah Hoke examined player-to-player communication constraints in *Sky: Children of Light* (2019) as a corrective response to toxic interactions. Adopting a hybrid formalist and structuralist approach, JaQuacia McClaney analyzed the developers' strategic use of the unreliable narrator trope in the survival horror game *The Quarry* (2022). Both students previously presented their work at the 2024 College English Association conference. *Mentor: Dr. Mitch Frye*

The Impact of Altered Magnetic Field Strength on Adherence to Pheromone Trails in *Pogonomyrmex occidentalis*

Jonathan Mundy

The geomagnetic field has been known to affect various species of ant during foraging activities, with it playing a role in navigation in settings where other cues such as light or pheromones are lacking. *Pogonomyrmex occidentalis*, or the western harvester ant, is found in the Midwestern United States and serves as an easily accessible model to assess the role that an increase of magnetic field strength would have on ant foraging behavior. In this work, it was assessed whether a difference could be determined in foraging for food when magnetic field strength is increased (from ~21 microteslas to ~5180 microteslas) with relation to the location of the food items. An increase in magnetic field strength increased the concentration of foraging workers at food sites and allowed the ants to access the food items with greater speed (Over a period of 15 minutes, more ants of the total 17 ants were observed to orient with a certain direction in trial one as compared to the control). These results suggest that an increase in the geomagnetic field will allow for ants to more efficiently and more readily navigate themselves to target food items. This study helps to lay a foundation for future research into understanding the evolution of the hierarchy of sensory systems in foraging animals and how sensory systems have changed in preference throughout the evolutionary history of foraging animals. *Mentor: Dr. Natalie Ortell*

The Impact of Ocean Acidification on *Tetraselmis sp.*

Chloe Dykes

Environmental pH changes can negatively impact many species or lead them to adapt and fill new ecological niches. At the base of all oceanic food webs are photosynthetic microalgae. With the change in the ocean's pH levels, the impact it will have on primary productivity is important to understand. *Tetraselmis sp.* is investigated for applications in the fields of nutrition, medicine, and biofuel. This research aimed to show what the impact of ocean acidification is on *Tetraselmis sp.* growth, chlorophyll-a concentration, and expression of the RSP10 gene. By utilizing an F/2 media, with 3 controls at 8.2 pH and 3 experimental replicates at 5.0 pH, samples were collected for cell counts, chlorophyll-a concentrations, and DNA extraction. Experimental flasks exhibited a faster growth rate of 100% surpassing the original flask's cell count and the controlled cell count which amounted to 96.5% growth. While statistically, the chlorophyll-a data is not significantly different between the experimental and control, the trends of the data still show that there is a difference between the two, and the experimental was greater (T-test, $p < 0.1$). When looking at for the cell counts at data, the same can be said about T2 and T6, but T1, experimental flasks were shown to be significantly different than in having the control greater than the experimental. This suggests as a response to pH stress, *Tetraselmis* chose to divide more rapidly and that there was also considerable productivity in the cultures, suggesting that this species has a positive reaction to stress. *Mentor: Dr. Natalie Ortell*



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Investigating the Aerodynamics of Proposed Airplane Wing Flaps on the F/A-18

Camryn Bedgood

When fighter jets, such as the F/A-18 are used at sea, they must be able to land on very short runways, which are approximately 300 feet in length. This is a complex and dangerous maneuver that relies heavily on the design of the jet's wing flaps, as the wing flaps can speed up the deceleration time by increasing the amount of drag on the jet. This, in turn, can make the maneuver safer for pilots. In this project, various wing flap designs were developed using computer-aided design software and were tested using computational fluid dynamics in order to try and determine which design would result in the greatest amount of drag, the results of which will be discussed in this presentation. *Mentor: Dr. Jessica Alexander*

Investigating the Use of Eco-Friendly Materials in Construction

Narae Kim

In the atmosphere, carbon rates have been increasing rapidly. This leads to global temperatures rising, organisms' environments being destroyed, increased risk of forest fires and droughts, and many other negative effects. One of the main causes of carbon emissions is the production of the materials used in construction or the construction of new buildings. To develop a potential solution to this problem, I am using computer-aided design (CAD) software to create a 3D model of a residential building. Then, I will utilize stress simulations to see how the structural integrity of more environmentally friendly options, like bamboo and eggshell waste, compares to commonly used construction materials, such as concrete and steel. Through my research, I aim to determine if the environmentally friendly options will be able to replace common construction materials in an effort to reduce the causes of climate change in construction by emitting less carbon. *Mentor: Dr. Jessica Alexander*

A Leatherback Sea Turtle (*Dermochelyidae*) from the Lower Oligocene (Rupelian) Byram Formation of Alabama, USA

Kimberly Gregson

The family of leatherback sea turtles (*Dermochelyidae*) has only one extant representative (*Dermochelys coriacea*) but leatherback species richness was considerably higher during the Paleogene with seven recognized genera and at least three distinct lineages. Attempts to resolve the phylogeny of *Dermochelyidae* are routinely impeded by low specimen counts for fossil taxa, largely incomplete fossil specimens, and the resulting lack of phylogenetically informative characteristics that can be derived from the available fossil material. Here we report a nearly complete dermochelyid carapace recently recovered from the Lower Oligocene (Rupelian) Glendon Limestone Member of the Vicksburg Group in Monroe County, AL. This specimen represents the first Oligocene dermochelyid described from Alabama and one of the most complete fossil leatherbacks currently known. The preserved carapace is nearly 1.5 meters in length and consists of the typical mosaic of bony ossicles characteristic of dermochelyids. This specimen provides an opportunity to test the validity of diagnostic character suites proposed for historically described species of fossil leatherback and enables more in-depth analyses of dermochelyid osteology and phylogeny than have previously been possible. *Mentors: Dr. Michael Burns, Mr. Jun Ebersole, Dr. Gentry, Dr. James Parham*

The Link Between Energy Drinks, Sugar, and Caffeine to Dental Carries

Carly Layfield

This research looks at the effect energy drinks, and their major components (caffeine and corn syrup) have on a negative oral bacterium, *Lactobacillus acidophilus* (La). La is a known carie causing bacteria meaning that many links have been made to the bacterium and cavity growth. By looking at the growth rate of La in relation to different components of energy drinks it shows which components have a more negative effect on the oral biome and would lead to higher cavity growth potential. By examining this bacterium with different components that have not been tested before it can show how a very common drink for students actually affects them. La was grown for 5 days at 37C on MRS agar media plates (in triplicate per exposure) with the experimental food type layered



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between agar layers. Each day CFUs were quantified using the OnePetri application. The growth rate of La on corn syrup was statistically enhanced compared to all other exposures (ANOVA, post-hoc Tukey test, $p < 0.005$). While La growth rate on energy drink was statistically enhanced compared to control and corn syrup (ANOVA, post-hoc Tukey test, $p < 0.005$). The significant increase in average CFU counts for corn syrup and energy drinks suggest diets high in those ingredients would lead to a cavity probability. Schools and students could apply this research when deciding their meal plans and diet choices. *Mentor: Dr. Natalie Ortell*

A marine invertebrate assemblage from the Red Bluff Formation of Alabama, USA

Abigail Richardson

During the Eocene epoch (56 - 33.9 mya), the Earth's climate was more than 8 degrees Celsius hotter than it is today. The end of the Eocene marks a rapid transition toward the ice age of the early Oligocene (33.9 - 23 mya) and the beginning of the glacial-interglacial cycle. Although this period holds great significance, there is little known about the effect that this transition had on the marine life living in what is now Alabama. Site AMo-9 in Monroe County, Alabama has been found to yield an abundance of invertebrate fossils hitherto undocumented in this state. Through this study, various species have been identified, including species of gastropods, echinoderms, and bivalves, many of which are index fossils that confirm the age of the site to be the lowest Oligocene. In this work, these species are discussed and illustrated. Then, using information derived from the extant relatives of these animals, it was determined that this site was a near-shore, tropical, marine environment. This study can be used as a reference for furthering the knowledge of marine ecology in the early Oligocene of the Gulf Coast Coastal Plain and showing how marine life responded to a period of rapid climate change. *Mentor: Dr. Andrew Gentry*

Media Discourse Analysis: 2023 NCAA Women's Basketball Championship Comparative Media Portrayal of Angel Reese v Catilin Clark

Jordan Simmons

This research project is a media content analysis comparing and contrasting the media coverage of Catlin Clark and Angel Reese during the 2023 NCAA Women's basketball championship and the aftermath. In 2023, the BIG 10 and SEC divisions competed in the championship game. The top players from each respective division, Catlin C. (BIG 10) and Angel R. (SEC) had a huge rivalry portrayed in the media. Throughout this project I will analyze how the media coverage of the game and the time after made the rivalry about race and less about skill on the court to each athletes' perspective on the game itself. The methodology used in my project analysis is data collecting articles, posts from verified accounts, and videos. I also used word coding to identify the language used with each player. *Mentor: Ms. Mandy Barefoot*

Modeling climate change induced schizophrenia through heat exposure and gene expression in Drosophila melanogaster

Serika Patel

Climate change is an urgent issue occurring as temperatures rise with a projected increase of about 9°C post the year 2100. Schizophrenia, a complex yet devastating neuropsychiatric disorder, results in a combination of hallucinations, delusions, disordered thinking, and unusual behavior. Despite the large number of genetic variants associated with schizophrenia, few causal variants have been established and there is no consistent evidence for specific genes that contribute to schizophrenia risk. Symptoms of schizophrenia do not tend to appear until adolescence or young adulthood. The hypothalamus is a temperature regulator which is commonly disrupted in schizophrenic patients- hence it was the factor observed in this study. To determine the impact of increased temperature exposures on schizophrenia, a model organism, *Drosophila melanogaster*, was exposed to projected temperatures (21°C and 30°C) for 5 days, wing flicks (a sign of stress and aggression) were measured twice each day, and the DH31R gene, a homolog for the hypothalamus, expression was measured. Observational results indicate stress is occurring among the *D. melanogaster* exposed at a temperature 9°C higher than average.



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A T-Test assuming equal variances determined significant differences in wing flicks between the control (21°C) and experimental (30°C) flies for trial 1 ($p=0.006$) and trial 2 ($p=0.003$). Increased expression of DH31R will be determined via PCR where amplified expression of DH31R signifies that increased temperatures influence the aggression of schizophrenia among affected individuals. Mentor: Dr. *Natalie Ortell*

Proposing and Simulating a Novel Solar Sail Deployment Mechanism for Nanosatellites

Yunseo Ha

The rise of public interest in space exploration has sparked the development of new satellite technologies, such as CubeSats, that are making space research more accessible for scientists around the world. Solar sails are a promising propulsion technology for long-range CubeSat missions, but their deployment methods must improve before they can be utilized reliably. In this project, a newly designed solar sail deployment mechanism called the “pusher” is modeled in a computer-aided design software with variations in stowage position and number of panels. A random vibration analysis (RVA) is performed on the models in a simulated rocket launch environment under random vibroacoustic perturbations. Preliminary results for all successful trials show an average expected deformation frequency of 24.8 Hz, with major deformations at the tips of the sails where the structures are least supported. The response power spectral density (RPSD) curves reveal a lower response (higher stability) for the stowed model compared to the deployed model, and a similar response between the four-paneled and six-paneled models. Overall, the RPSD curves for all trials fall under the threshold for the maximum predicted vibration response, suggesting that this design could be a viable deployment method for solar sails in future CubeSat missions. *Mentor: Dr Jessica Alexander*

Space-Tether Deployment Mechanism Using an Eddy Current Brake

Ella Brochu

Space debris, which refers to decommissioned human-made objects in space, usually in Earth’s orbit, which no longer prove useful, poses a threat to the sustainability of space exploration and utilization. Specifically, it poses a threat to operational satellites, spacecrafts, and future space missions. As a result, many space debris capture and removal methods have been proposed in the last decade with a multitude of different approaches, from capturing debris using mechanical arms to catching them with a casting net. However, the main problem that arises in such mechanisms is the deployment of the tether system in the early stages of the mission, specifically, the tether deployment process is complicated and causes unwanted vibrations throughout the tether. These unwanted vibrations, as a result, can lead to the kinetic energy being used to separate different parts of the satellite which could cause the entire system to fail. This paper seeks to solve this problem through the implementation of an eddy-current braking system, which slows or stops an object by creating eddy currents and therefore depleting any kinetic energy as heat. The purposed system uses an electromagnet that is turned on and off at varying distances in order to test the effectiveness of using eddy-current brakes in order to mitigate any problems that would arise otherwise.

A Spectrum of Perception: Exploring Racial Representation and Codification in Disney's Animated Characters

Jayden Cooper

This research gauged the understanding of racial codification of non-human characters in Disney films that perpetuate a relationship between non-whiteness and animality. It used a survey format with video clips embedded and prompted participants to decide which racial demographic the characters best fit into and what characteristics led the participant to this conclusion. At the end of the survey, the participants were asked personal demographic questions. The survey had 173 respondents, mostly staff and students at the Alabama School of Math and Science and students’s faculty and staff associated with the University of South Alabama. It was initially hypothesized that white participants would fail to realize the racial undertones of non-human characters in more



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recent films, while non-white participants would be able to perceive the underlying racial undertones more fluently, as evidenced by their responses. It was also projected that participants more educated in the humanities will be more receptive to racial codification than STEM-educated participants. The results revealed that accent and voice acting served as the most prevalent racializing factors and that respondents at the highest level of education were less likely to be sure of the race of a character. *Mentor: Dr. Nicole Amare, Mrs. Katherine Koury*

Sustainable Mining Through Advanced Borehole Mining and Algal Carbon Sequestration

Omolabake Elenitoba-Johnson, Omar Hernandez-Tena, Jonathan Hulcher, Emma Saalwaechter

Lithium usage has risen in recent years because of breakthroughs in battery technology. At the core of this lithium-dependent world is the harsh reality of unethical and environmentally damaging mining methods. The Thacker Pass lithium deposit in Humboldt County, Nevada, for example, is proposed to become an open-pit clay mine, which would release 150,000 tons of carbon dioxide per year. Utilizing advanced borehole mining techniques and algal carbon sequestration, Thacker Pass could be transformed into a more sustainable mine. Controlling carbon dioxide release is paramount. By using carbon-capturing algae in an engineered steel, geodesic dome, the algae could be the key to preventing mass carbon dioxide emissions stemming from the mining process. In implementing said techniques, the environment of the Thacker Pass mine will have significantly fewer environmental consequences than open-pit mines across the globe while being able to successfully harvest the rich lithium ore located within it. *Mentor: Dr. Elisa Rambo*

Terrestrial Radiation along the Gulf Coast

Brandon Hunt, Emily Imperato, Griffin Overton, Christopher Palmer, Eleanna Soto

The Gulf of Mexico is a hotspot for offshore oil drillings. Simply in Mobile Bay alone there are at least 80 gas and oil drills. In April of 2010, the largest oil spill in history occurred. The Deepwater Horizon spill released an estimated 200 million gallons into the Gulf of Mexico and surrounding waters, including Mobile Bay. The study's goal is to find if the Deepwater Horizon spill had a negative effect on the shores of Alabama by increasing radiation counts in the ground. 15 home samples from around Alabama, including ones on the coast, were gathered and tested for radiation. Samples from other states and certain minerals were tested as well for control. The farther from the coast where samples were collected, the more radiation was detected. The coastal samples had the least amount of radiation. However, samples collected on self-sustained bodies of water, like ponds, had the most amount of radiation. This is most likely due to the difference in ground types, such as the sand's sedimentary nature, not being sufficient at storing radioactive materials. While the Deepwater Horizon spill should have increased radiation levels on the coast, the samples collected there showed the opposite. *Mentor: Mr. Kevin Dolbear*

Using Artificial Intelligence for Mathematical Studies

Rachel Jordan, Anna Watson, Novita Whillock

Artificial Intelligence has been used in many fields for higher learning and as a tool for problem solving. This research investigates the capabilities and limitations of artificial intelligence such as ChatGPT, Wolfram Alpha, and GeoGebra for tutoring and problem solving in mathematics across subjects such as linear algebra, pre-calculus, calculus, and math problem solving. Researchers input math questions into ChatGPT and other related programs to test the accuracy and mathematical intelligence of the programs. It has been found that ChatGPT is very knowledgeable concerning mathematical theories across all subjects but often makes arithmetic errors on complex problems. However, when it comes to calculus, ChatGPT makes minimal to no mistakes, as where Wolfram Alpha gives accurate and correct answers every time because of the advanced coding system used. Researchers also found that ChatGPT has other applications that can be used for presentations and other applications to teach mathematics to struggling students. Furthermore, our findings corroborate the narrative that



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Artificial Intelligence is a helpful tool for math tutoring and problem solving, although some computer programs may have some arithmetic limitations. *Mentor: Ms. Natalya Prokhorova*