



# ALABAMA SCHOOL OF MATHEMATICS AND SCIENCE 2026 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

**Dr. Bob Ashurst, c/o 1994**  
**1:15 pm - Auditorium**

### Paper Presentations & Panels 2:00 pm - 4:30 pm

#### Wilson Science Research Center 107

- 2:00 pm *BacGel Therapy: A Novel Treatment for GI Cancer* - **Amna Hadi, Hyerin Park, JaTaviah Tarver, Karighan Womack**
- 2:30 pm *Improving Laboratory Education* - **Scarlet Cunningham, Joshua Lowery, Arina Markina**
- 3:00 pm *Cryptocurrency and Blockchain: The Future of Digital Finance?* - **Jacob Kim, Jesus Flores, John Foster, Cooper Swindle**
- 4:00 pm *Alumni Panel - Engineering, Medicine, Science, Research*

#### Wilson Science Research Center 109

- 4:00 pm *Alumni Panel - Law, Leadership, Education*

#### Wilson Science Research Center 118

- 2:00 pm *Mapping Patronage: Revealing Elizabethan England Overseas Exploration and Expansion Promotion and Patronage Networks* - **Elizabeth Dismukes, Jeffrey Jeffrey, Reece Nolfe**
- 2:30 pm *"Knight in Dark Armor:" Masculinity in Hard-Boiled Detective Novels* - **Patrick Graham, Hanna Sagan, Ryan Teague, Sebastian (Forrest) Yee**
- 3:00 pm *Natural Disasters in Literature* - **Liv Hall, Caitlyn Nerbonne, Emma Newsome**
- 3:30 pm *Literary Research on Selected Works of F. Scott Fitzgerald* - **Jiro Culbertson, Alton Raburn**

#### Wilson Science Research Center 227

- 2:00 pm *From Your Plate to Preservation, Powering Oyster Conservation with Gen Z's Media Influence* - **Meredith Adams, BoKyeong Kim, Kayty Phan, Emma Kathryn South**
- 2:30 pm *Understanding and Addressing Anxiety of Robot-Assisted Surgery of Gastrointestinal Surgery Patients* - **Clyde Davis**
- 3:00 pm *Three Sisters Rethought: An Analysis of the Micro-Nutritional Effects and Economic Implications of Indigenous-Based Companion Planting* - **Henry James Cook**

### Poster Session

**2:00 pm - 4:00 pm**

**Wilson Science Research Center: 1st and 2nd Floor Hallways  
Bedsole Art Gallery**

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# ALABAMA SCHOOL OF MATHEMATICS AND SCIENCE 2026 SPRING RESEARCH FORUM

## **Abstracts** (alphabetical order)

### ***Analysis of Microplastic Debris along the Gulf Coast***

**Kameron Cotter, Abigail Faggard, Zahara Holland, Lilly Nguyen, Samuel Rinehart, Daniel Zheng**

Microplastics have increased over 100% in aquatic environments in the last 10 years, leading to detrimental effects on marine ecosystems. To better understand patterns of microplastic pollution, this study investigated microplastics along the Gulf of Mexico to see how concentrations vary over location and time. Water samples were collected chronologically by visiting 2 sites per collection interval. In addition, samples were collected at 9 sites at once for geographical analysis. Each sample was processed via vacuum filtration to isolate microplastics and organic matter. A standardized procedure was used to analyze the density of microplastics. The filtered samples were studied using microscopes to identify and quantify microplastics and other foreign matter based on characteristics such as size and color. Data consisted of the mass of the filtered sample before and after drying, the volume of water after filtration, and microplastic analysis data. The data from chronological sampling and geographical sampling were compared to understand patterns of microplastic pollution along the Gulf. *Mentor: Mr. Kevin Dolbeare.*

### ***BacGel Therapy: A Novel Treatment for GI Cancer***

**Amna Hadi, Hyerin Park, JaTaviah Tarver, Karighan Womack**

Gastrointestinal cancer rates have been rising sharply among younger adults. Sadly, gastrointestinal cancer accounts for 1 in 4 cancers and 1 in 3 cancer deaths worldwide. This high death rate can be reduced with BacGel, a cost-efficient and low-risk therapy for treating GI cancer as the number of cases grow in the future. BacGel Therapy combines an anaerobic bacterium and a hydrogel into a therapeutic delivery system that targets cancer cells in the GI tract. The hydrogel system will contain and control the effects of tumor lysis after the anaerobic bacteria, *Clostridium novyi-NT*, has released enzymes that break down the tumor cells. As gastrointestinal cancer rates continue to rise, BacGel Therapy provides a revolutionary treatment that is more accessible and lower risk compared to existing treatments involving chemotherapy and radiation. *Mentor: Dr. Elisa Rambo.*

### ***Defining Novel sdRNA Contributions to Pancreatic Cancer***

**Yanghong Chi, Scarlet Cunningham, Kayla Ho, Jaiden Russell**

According to the American Cancer Society, pancreatic cancer is estimated to be the third highest cause of cancer-related deaths in 2025. Pancreatic cancer also has an average 5-year survival rate of 13%, and between 50-55% of tumors have metastasized at the time of diagnosis. This is caused in part by the recommendation against screening for pancreatic cancer in asymptomatic adults due to its relatively low prevalence. Additionally, the most used serum biomarker, CA19-9, is ineffective as a sole diagnostic tool because of its low positive predictive value as well as high rate of false positive findings. Classically, small nucleolar RNAs (snoRNAs) were thought to primarily function in posttranscriptional modification of ribosomal RNA. Recent findings have indicated that snoRNAs are further processed into small nucleolar RNA-derived RNAs (sdRNAs). Dysregulation of sdRNAs is thought to contribute to both oncogenesis and cancer progression. Previous work from our lab has demonstrated that overexpression of sdRNA-93 and sdRNA-D19b increases invasion in breast cancer and migration in prostate cancer, respectively. Kawai et al. demonstrated that miRNAs could serve as effective biomarkers for early detection of pancreatic cancer when paired with CA19-9. We hypothesize that sdRNAs will serve as even more accurate serum biomarkers to aid diagnosis of early-stage pancreatic cancer. We also sought to determine if sdRNAs could serve as potential therapeutic targets for pancreatic cancer. *Mentors: Dr. Glen Borchert, Grayson Cole, George Naman, University of South Alabama.*



# ALABAMA SCHOOL OF MATHEMATICS AND SCIENCE 2026 SPRING RESEARCH FORUM

## ***Design, Analysis, and Manufacturing Optimization of a 12U CubeSat Access Panel: A Multidisciplinary Trade Study***

**Derek Ricafort**

This study presents a finite element analysis framework for optimizing the structural and thermal performance for a 12U CubeSat access panel under Low Earth Orbit conditions. Eight variants combining two aluminum alloys (Al 6061-T6 and Al 7075-T6), three panel geometries (rectangular, elliptical, and hexagonal), and four surface finishes (bare, alodine, black anodize, hard anodize) were evaluated using 2D plane stress FEA and a lumped-parameter thermal model. Structural simulations assessed von Mises stress, natural frequency, and factor of safety under 20g quasi-static launch loading, while the thermal model predicted transient orbital temperature responses and thermal cycling stress under normal and worst-case hot scenarios against ECSS operational limits. Results showed that Al 7075-T6 with alodine coating and rectangular geometry provides the optimal combined performance, achieving a factor of safety of 272 against yield - nearly double that of the Al 6061-T6 baseline - while maintaining orbital temperatures within  $\pm 6^\circ\text{C}$  and thermal cycling stress below 8 MPa. Surface finish was found to dominate thermal behavior, with anodized coatings producing temperature ranges 5-8 times larger than bare or alodine-coated surfaces. Mesh convergence was verified across 13 mesh densities, confirming that a 40x40 element mesh provides results within 5% of the finest mesh tested. *Mentor: Dr. Michael Halvorson, Auburn University.*

## ***The Effect of Turbidity and Nutrient Content in Mobile Bay on Phytoplankton Biomass***

**Alex McElroy**

Federal mud dumping in Mobile Bay has been conducted periodically for over 2 decades, and has numerous environmental impacts, including phytoplankton productivity. Dredging has a bidirectional effect on phytoplankton biomass. A decrease in phytoplankton biomass results after dredging increases localized turbidity, reducing the amount of sunlight available to photosynthetic organisms. An increase in phytoplankton biomass can occur after dredging if dredge material contains nutrients that create eutrophic conditions. Simulated bay water model conditions will be optimized after determining the relationship between transmission and concentration of suspended material in water and analyzing existing long-term datasets for nitrogen and phosphorus levels in Mobile Bay. Deepening and widening of the Mobile ship channel dredge conditions will be simulated from the model parameters, to determine the effect of increased turbidity and nutrients on Mobile Bay phytoplankton. We hypothesize that as both turbidity and nutrients increase, chlorophyll- $\alpha$ , a proxy for phytoplankton biomass, will decrease. Experimental results will establish what impact increased turbidity and nutrients from dredging have on Mobile Bay phytoplankton. Because of their role as primary producers, these results will provide insight on how dredging may affect other organisms in Mobile Bay. *Mentor: Dr. Rebecca Domangue, Dr. Jeffrey Krause, University of South Alabama, Dauphin Island Sea Lab.*

## ***Looksmaxxing or Dangermaxxing: The Correlation Between Facial Width-to-Height Ratio and Perceived Threat***

**Anna Dobbins, Alexandria Sheffield**

This study examines the relationship between facial width-to-height ratio (fWHR) and perceived threat. Using AI-generated faces, we created paired stimuli in which one image remained unaltered and the other was modified to be wider by one standard deviation, increasing its fWHR. Participants completed a survey in which they were presented with each image alongside a brief scenario and asked to respond to behavioral and perceptual questions. These included whether they would avoid the individual (e.g., cross the street), as well as rating the person on a 1-5 scale for traits such as aggression, likelihood of criminal behavior, attractiveness, and likelihood of possessing a weapon.



# ALABAMA SCHOOL OF MATHEMATICS AND SCIENCE

## 2026 SPRING RESEARCH FORUM

Results were analyzed to determine whether faces with higher fWHR were consistently associated with increased perceptions of threat and negative behavioral expectations. Findings suggest a measurable correlation between increased facial width and heightened perceptions of aggression and danger, supporting existing theories that facial structure can influence social judgments. This research highlights the role of subtle facial cues in shaping bias and decision-making in everyday social interactions. *Mentor: Dr. Jack Shelley-Tremblay, University of South Alabama.*

### **Cryptocurrency and Blockchain: The Future of Digital Finance?**

**Jacob Kim, Jesus Flores, John Foster, Cooper Swindle**

Blockchain technology is a new technology that enables a wide range of applications in the field of finance. This paper provides a comprehensive review of blockchain technology, covering its historical development, conceptual foundations, and real-world applications. The study serves as a broad overview for understanding how blockchain systems function and why they are considered trustworthy infrastructures. The paper examines the risks associated with cryptocurrencies through the analysis of log returns, lognormal distributions, and formal normality tests. This study examines whether classical distributional models adequately capture the behavior of these assets. It also argues that properly recognizing and analyzing lognormal data leads to more efficient experimental design and more reliable scientific conclusions. In this paper, we introduce the NormalLognormal (NLN) mixed distribution to model long-term profits of firms. We also examine the trade-off between controlling inflation through interest rate hikes and maintaining financial stability. We conclude that higher investor sentiment is positively correlated with higher average market capitalization and increased dispersion among firms. *Mentor: Ms. Natalya Prokhorova.*

### **Electrocardiographic Feature Analysis in the Classification of Cardiac Arrhythmias**

**Anush Mainali**

Cardiac arrhythmias, abnormal heart rhythms that affect millions of people worldwide, are a leading cause of sudden cardiac death. Electrocardiograms (ECGs) record the electrical activity of the heart and are the primary tool used to detect and classify these conditions. This study uses PhysioNet's publicly available ECG recordings to analyze key waveform features like heart rate, R-R interval, and QRS duration. Data is extracted from three heart rhythm classifications: normal sinus rhythm, atrial fibrillation, and ventricular tachycardia. Then, it is compared across rhythm types to observe which electrocardiographic features are best able to distinguish the arrhythmias from normal activity.

### **An Engineered System Concept for Early Detection of Dry-Type Transformer Failures**

**Eden Fillingim, James Lott, Bryan Nguyen, Reid Onderdonk, Angeline Welsh**

Dry-type transformers serve as critical nodes in modern electrical distribution networks and utilize solid dielectric insulation to maintain operational integrity. Throughout their operational lifecycle, these insulation systems experience thermal and electrical stressors that precipitate significant dielectric degradation. A primary precursor to catastrophic failure involves the onset of corona discharge. This localized partial discharge initiates impact ionization in the surrounding air. The process creates a self-sustaining plasma field that chemically and thermally erodes the insulation and accelerates the progression toward a total dielectric strike-over. This paper proposes a conceptual engineered system for the early detection of impending transformer failure. The system monitors the concentration of gaseous by-products, specifically Ozone (O<sub>3</sub>) and Nitrogen Oxides (NO<sub>x</sub>), which the corona ionization process generates. By utilizing active air-aspirating technology, the proposed system offers a non-invasive and EMI-immune diagnostic alternative to traditional Ultra-High Frequency and thermal monitoring techniques. The study evaluates two primary integration strategies. The first strategy interfaces with Fire Alarm Control Panels for life-safety supervision. The second strategy utilizes Building Automation Systems via protocols

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## 2026 SPRING RESEARCH FORUM

such as BACnet or Modbus for real-time trend analysis. This framework shifts the maintenance paradigm from reactive to condition-based monitoring. It provides facility managers with a strategic response window to mitigate business interruption and prevent cascading infrastructure failures. *Mentors: Dr. Bhushan Lohar, Dr. Tom Wade, University of South Alabama.*

### ***Evaluation of Hybrid Active-Passive Radiation Shielding***

**Ben Le**

Orbital data centers represent a promising solution for sustainable computing infrastructure, leveraging renewable solar energy and the vacuum of space for thermal management. However, the Low Earth Orbit (LEO) radiation environment, trapped protons and electrons, poses significant challenges to commercial off-the-shelf (COTS) electronics. This study evaluates the effectiveness of a hybrid shielding architecture, integrating active electrostatic deflection with passive, layered material absorption, to reduce system mass and radiation dosage. *Mentor: Dr. Mark Byrne.*

### ***From Your Plate to Preservation, Powering Oyster Conservation with Gen Z's Media Influence***

**Meredith Adams, BoKyeong Kim, Kayty Phan, Emma Kathryn South**

After investigating the effects of ocean acidification on homeostasis, growth, immunity, and maintenance of *Crassostrea virginica* and presenting the research project's findings at conferences, the team focused on informing the public on ocean literacy by utilizing the power of social media. Through advocacy, audiences are empowered to fight legislation that weakens Alabama's environmental regulations. One organization that emphasizes this is the Alabama Coastal Foundation (ACF), which was founded to protect the coastal environments in Alabama. A key program is their Oyster Shell Recycling Program, where, currently, 32 restaurants across coastal Alabama participate to put oyster shells back into Mobile Bay as reefs, boosting larval oyster settlement and supporting oyster reef conservation. ACF has successfully collected more than 28 million pounds of shells in the last 10 years and restored over 100 acres of reefs. Active learning and engagement are the key to true "buy in" with outreach. Through multiple mediums, including the creation of animated characters to illustrate the benefits of the oyster shell recycling program, social media "challenges" to engage the public, and generating informative messaging for restaurants, the team collaborated with ACF to promote their oyster conservation message in a format that the audience can engage with. *Mentors: Dr. Rebecca Domangue, Dr. Natalie Ortell.*

### ***HELZ-2 (Helicase with Zinc finger 2) effect on the repression of Dengue virus (DENV)***

**Alexa Beech, Brandon Boeur, Annelise Drouin, Xavier Drouin, Libbie Hamilton, Sachi Patel**

The mosquito-borne Dengue virus (DENV) manifests in a wide variety of symptoms, which can lead to serious complications and death. While DENV typically affects countries with tropical climates, cases of DENV have been increasing over the past few years. Interferon (IFN) is a host antiviral cytokine that typically suppresses DENV, but its effectiveness has been limited by DENV's subversion of IFN signaling. Direct activation of downstream genes required for IFN antiviral effects (IFN effectors) may overcome this subversion, providing leads for antiviral development. Through previous research using RNA inhibition, HELZ2 (Helicase with zinc finger 2) was identified as an IFN effector against DENV in vitro. To validate these findings, HELZ2 knockout (HELZ2<sup>-/-</sup>) mice have been obtained for comparison of DENV infectivity in HELZ2<sup>-/-</sup> vs wild type (WT) mice by using primary bone marrow-derived macrophages (MACs) as the host. We hypothesize that primary MACs from HELZ2<sup>-/-</sup> mice will be hypersusceptible to DENV and resistant to IFN-mediated DENV suppression, compared to WT MACs. Methods: cells were isolated from 78 mouse femurs, followed by incubation for 24h, expansion for 7 days, with differentiation into MACs using cytokines mCSF and mIL3, then freezing at -80 °C. Results: Cell survival rates in



# ALABAMA SCHOOL OF MATHEMATICS AND SCIENCE 2026 SPRING RESEARCH FORUM

culture are high. Future Directions: DENV infection will be compared between WT and HELZ2-/- using qRT-PCR of RNA extracted from MACS +/- DENV. *Mentor: Dr. Dahlene Fusco, University of South Alabama.*

## ***Imagination as Survival: Afrofuturism and Afropessimism in OutKast's Music*** **Arliyah Grayson, Kierra Hodges, Ian Teague**

Since the 1990s, the Atlanta hip-hop duo OutKast has occupied a singular place in American music. At a time when mainstream hip-hop was largely defined by the cultural dominance of the East and West Coasts, André 3000 and Big Boi emerged from the American South with a sound that was stylistically innovative, regionally distinctive, and philosophically complex. Their music blends Southern storytelling, funk instrumentation, and experimental production with vivid metaphors of space travel, alienation, and transformation. Through these elements, OutKast created a sonic world in which the realities of Black Southern life coexist with imaginative visions of liberation and possibility.

This paper examines OutKast's catalogue through the theoretical lenses of Afrofuturism and Afropessimism. Afrofuturism envisions Black futures through the creative use of science fiction, technology, and speculative imagination, often reclaiming narratives that have historically excluded Black voices. Afropessimism, by contrast, emphasizes the structural and enduring nature of anti-Blackness in modern society and questions the possibility of full liberation within existing social frameworks. While these perspectives may appear to be in tension, both emerge from attempts to understand the historical and contemporary conditions of Black life.

OutKast's music uniquely embodies the dynamic relationship between these two frameworks. Across albums such as Southernplayalisticadillacmuzik, ATLiens, Aquemini, and Stankonia, the group constructs narratives in which imaginative escape and structural constraint exist simultaneously. Images of extraterrestrial alter egos, futuristic Cadillacs, and cosmic travel coexist with depictions of economic hardship, violence, and social marginalization in Atlanta's urban landscape. In this way, OutKast's work demonstrates that visions of Black futurity are often shaped by the very conditions that limit them.

This paper argues that OutKast reconciles Afrofuturist imagination with Afropessimist realism by using speculative imagery, sonic experimentation, and Southern storytelling to envision Black futures while simultaneously confronting the structural limitations imposed on Black life in America. By analyzing key albums and lyrical themes, this study shows how OutKast's music transforms the experiences of the post-civil rights Black South into a form of cultural world-building that is both critical and visionary. *Mentor: Dr. John Hoyle.*

## ***Impacts of Imperata Cylindrica on the Biodiversity and Abundance of Native Grass Species on Dauphin Island*** **Lena Andrews**

*Imperata Cylindrica*, also known as Cogongrass or Japanese Bloodgrass, is an invasive grass species originally introduced to the southeastern United States in the 1930's. It has been characterized to have high resistance to standard control methods, and has demonstrated significant ecological impacts on local ecosystems, including Dauphin Island's Audubon Bird Sanctuary. Utilizing random sampling, different areas within this forest with grass presence were assessed to see abundance and biodiversity. To contextualize these findings, this study incorporates a comparative analysis of similar research done in other southeastern areas surrounding cogon grass. This analysis examines the similarities of impact caused directly by this invasive grass species, as well as past methodologies used to mitigate its spread. These findings aim to provide additional insights on the impact of this grass and what management methods may provide to be most effective in the future. *Mentor: Ms. JoAnn Moody, Dauphin Island Sea Lab.*



# ALABAMA SCHOOL OF MATHEMATICS AND SCIENCE 2026 SPRING RESEARCH FORUM

## ***Improving Laboratory Education***

**Scarlet Cunningham, Joshua Lowery, Arina Markina**

How can lab curriculum be edited to be more accessible to schools and instill a research-based mindset into students to improve their overall learning experience and knowledge level of the subject? We are making affordable and accessible experiments focused on allowing students to make conclusions and decisions for themselves will improve each student's overall knowledge of the topic conducted during the experiment. This topic has been researched by other scientists. It has been found that overall experiments in high school and college levels are lacking due to lack of resources or other reasons. Other scientists have focused on the outcome and advantages of switching to a research-based mindset. Our project will add actual experiments and data to this to determine if allowing students to draw their own conclusions using given information will improve their overall learning. We're using a Pre-Quiz for each experiment, Post - Quiz for each experiment, Sample Experiments with procedures (controlled and experimental), materials for experiments. *Mentor: Dr. Matthew Davenport.*

## ***Investigating the Use of Nuclear Reactors on Mars***

**Lucas Holley, Lucas Miller**

With the frontiers of mankind growing ever wider, an exciting and current topic is the possibility of long-term human settlement on Mars. In the harsh and restrictive environment of the Martian surface, options for energy production are limited. Solar is upkeep-heavy due to Mars's dust storms, and due to Mars's less dense atmosphere it is difficult to attain the efficiency of wind power seen here on Earth. All these factors point towards nuclear power as the most viable option for long term power generation for a Martian settlement. The current scientific data points to a Closed Brayton Cycle sCO<sub>2</sub> reactor as a feasible design for said reactor. One of the distinguishing features of this design is the waste gas recuperator, a device used to reduce wasted energy by running the hot turbine exhaust through the cool gas that is about to go back into the reactor to be heated. In this research project, we designed a recuperator using computer-aided design (CAD) software and utilized computer fluid dynamics (CFD) to test the performance of recuperators comprised of various materials under conditions similar to those on Mars in an effort to determine the most suitable material for the recuperator, the results of which will be discussed in our presentation. *Mentor: Dr. Jessica Alexander.*

## ***"Knight in Dark Armor:" Masculinity in Hard-Boiled Detective Novels***

**Patrick Graham, Hanna Sagan, Ryan Teague, Sebastian (Forrest) Yee**

The idea of hard-boiled masculinity is widely researched, such research includes, but is not limited to, Jopi Nyman's "Body/Language: Gender and Power in Hard-Boiled Fiction," and Jack Boozer's "The Lethal Femme Fatale in the Noir Tradition." However, current research does not fully explore the entanglement of gender roles and control during the post-war era in written media. Through the analyzation of detective literature created in post-WWII time, this study further explores the connection between gender roles and dominance during this period. Our team of researchers thoroughly analyze *The Maltese Falcon*, *The Big Sleep*, and *Strangers on a Train* alongside myriad research articles to provide insight on the intricacies of masculinity, femineity, and homosexuality through their characterizations. Our findings reveal that the masculine detective is often prone to violence, cynicism, or detachment, following the idea of stoicism as manly after the war, Femininity is written as sensitive yet manipulative, often using tactics that play on men's masculinity, and homosexuality is present as the overindulgent villain along with flamboyancy, following the opposite of the ideal, low-consumption life after the war. This paper expands the concept of post-war gender roles and power through the lens of hard-boiled detective novels, providing a fresh perspective. *Mentor: Mr. Daniel Commander.*

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## *Literary Research on Selected Works of F. Scott Fitzgerald*

**Jiro Culbertson, Alton Raburn**

Students in this project read a representative selection of F. Scott Fitzgerald's short stories, novels, and essays from different stages of his career. Then, they consulted scholarly sources such as biographies, letters collections, and journal articles to generate an annotated bibliography for the project. For their conference paper topics, Jiro Culbertson chose to analyze the complex treatment of failure (personal and financial) in Fitzgerald's writings, while Alton Raburn examined the role of midcentury automobile culture in his works. Both students are also drawing from this experience to present short essays on AI as a tool in the literary research process at the University of South Alabama's 2026 Conference on Teaching and Learning. *Mentor: Dr. Mitch Frye.*

## **Mitochondrial DNA Content Analysis in Prostate Cancer Patients**

**Dorian Gonzalez, Liana Jayasena, Kahyeon Jeon, Ella Thorjusen, Olivia Yoo**

Prostate cancer (PCa) remains the most frequently diagnosed non-cutaneous malignancy and the second leading cause of cancer-related mortality among men. The identification of biomarkers that helps to identify aggressive prostate cancer early remains a key concern in the clinic. Changes in mitochondrial DNA (mtDNA) has emerged as a key support system for malignant progression of cancer. Mitochondria are maternally inherited essential cytoplasmic organelles and contain their own DNA. Changes in mtDNA contents indicate alterations in mitochondrial function and could potentially be.

In this study, we measured mtDNA content in 15 men with a primary diagnosis of prostate cancer. Total genomic DNA was isolated from matched normal and cancer tissue and quantitative polymerase chain reaction (qPCR) was performed to determine the mtDNA abundance. Primers which target for mitochondrial DNA encoded genes MT-ND1, MT-CYTB, and MT-ATPase8 were used for quantifying mtDNA content, whereas, GAPDH was utilized as a reference nuclear-DNA encoded gene for normalization. The purpose of this study was to analyze the variability of mtDNA copy numbers through the comparison between the amplified product of mtDNA and the nuclear gene.

Inclusion of various mitochondrial targets helped in improving the quality of results, as there was an opportunity to perform comparisons between different parts of mitochondrial DNA and improve measurement accuracy. The current project shows the potential of using qPCR as a precise and readily available technique to examine genetic changes in relation to diseases such as cancer. The results show that changes in mitochondrial DNA content may play an important role in the development of aggressive prostate cancer. As a result, mtDNA deserves more attention as a disease marker. *Mentors: Rajarshi Banerjee, Saphala P. Loku Galappaththi, Charu Shastri, Christopher Keel, Dr. Santanu Dasgupta, Mitchell Cancer Institute.*

## **Machine Learning-Based Heat Sink Design via SDF Surface Area Maximization**

**Robert Trifas**

As our societal and intellectual reliance on LLMs like Gemini and ChatGPT increase, the water consumption their datacenters necessitate for cooling causes environmental issues in aquifer over drafting and ecosystem disruption. To decrease cooling costs, this paper seeks to apply a novel approach in heat sink design using an Artificial Neural Network (ANN). In typical neural implicit surface methods, the ANN fits a Signed Distance Function (SDF) to an input model to smoothly represent the model's geometry. In this paper, a new volume-surface area term is added to the loss function during a second round of training, which causes the neural network to maximize the surface area while keeping the volume constant or decreased. The resultant model is then meshed to analyze its heat dissipation performance using Computation Fluid Dynamics (CFD). Since heat sink efficiency is correlated to heat sink surface area, the researchers predict that the produced heat sink will be more efficient than traditional



# ALABAMA SCHOOL OF MATHEMATICS AND SCIENCE 2026 SPRING RESEARCH FORUM

designs. With this efficiency, datacenter cooling will be less taxing on the water supply, which will hopefully mitigate current LLMs' environmental impact. *Mentor: Dr. Jessica Alexander.*

## **Mapping Patronage: Revealing Elizabethan England Overseas Exploration and Expansion Promotion and Patronage Networks**

**Elizabeth Dismukes, Jeffrey Jeffrey, Reece Nolfe**

We will examine English promotional literature produced between 1550 and 1616, primarily focusing on the works produced and published by Richard Hakluyt the Younger and those connected to him, including the scholastic correspondence circle, the Republic of Letters, spanning mid- to late-16th-century Europe. Through a combination between court and merchant, with Hakluyt being a central focus. Our research in early modern literature will hinge on out access to Early Modern English Books Online, and our ability to research the individual figures that make up the patronage network will rely on access to the Oxford Dictionary of National Biographies. Using both of these databases, we will be able to search for the printed publications and the biographies of mid- to late-16th-century courtiers, authors and editors, and merchants to establish their ties and connections to each other or both professional and personal levels. *Mentor: Dr. Jennifer Tellman.*

## **Nail Salon-induced Alzheimer's Disease: Modeling Plasticity Loss in a CA1 Pyramidal Neuron to Increasing Concentrations of Formaldehyde**

**Alex Nguyen**

Formaldehyde, a common ingredient in nail polish and hardeners, is a volatile organic compound (VOC) where its chronic exposure is correlated with increased neurocognitive impairments, such as Alzheimer's Disease (AD). While previous research has continuously indicated the risk of neurocognitive impairments from chronic neurotoxin exposure, there has been no connection between occupational epidemiology and its cellular mechanisms. To investigate the cellular neuropathology linking VOC exposure to cognitive decline, we modeled formaldehyde at varying concentrations in a multi-compartment hippocampal CA1 pyramidal neuron implemented in the NEURON simulation environment using Hodgkin-Huxley kinetics. Our simulation produced a graded dose-response with a sharp failure transition between 0.30 and 0.50 mM formaldehyde, at which firing rate collapsed from 66 Hz to near-quiescence and the neuron entered a sustained depolarization block. NMDA-mediated synaptic amplification dropped nearly tenfold before firing failure, suggesting plasticity impairment precedes overt neuronal dysfunction. At high concentrations, frequency-current curves became non-monotonic, with increasing stimulation silencing the neuron through sodium-channel inactivation. These results suggest that formaldehyde damages the neuron's plasticity before it damages its excitability, matching how AD clinically progresses in patients.

## **Natural Disasters in Literature**

**Liv Hall, Caitlyn Nerbonne, Emma Newsome**

This research project explores how natural disasters have been depicted in literature over time. Tall tales and ancient myths, such as Genesis, give a non-scientific explanation for disasters and how they can be a punishment or a sign of some ki. This perspective gives a more humanitarian and less scientific view on how natural disasters occur, and how they relate to humanity. Jesmyn Ward's 21st century novel, *Salvage the Bones*, and Sarah M. Broom's memoir, *The Yellow House*, show issues in society surrounding disasters, specifically Hurricane Katrina. Help is often not given equally among communities based on race or economic status. As climate change becomes more of a worry, people reflect their thoughts in their writing; this produces works in the new literary genres of Climate Fiction and Eco-Dystopias. These works serve as a warning or "what if" to their audience. Novels like T.C. Boyle's *A Friend of the Earth*, Margaret Atwood's *Oryx and Crake*, and Sara Ruiz-Grossman's *A Fire so Wild* accomplish this idea. *Mentor: Dr. Karen Smith.*



# ALABAMA SCHOOL OF MATHEMATICS AND SCIENCE 2026 SPRING RESEARCH FORUM

## ***Neighborhood Organized Workers (N.O.W.), the American Junior Miss Pageant, and Stokely Carmichael; Re-Shaping the Perspective of the Civil Rights Movement in Mobile, Alabama***

**James Lott, Kaidence Patterson, Alayla Roussel, Razariah Stokes**

The history of the modern civil rights movement is dominated by narratives and images of dramatic confrontations between civil rights crusaders like Dr. Martin Luther King and antagonists like Birmingham City Commissioner Bull Connor. We can see the images of the Children's March in Birmingham, where young protesters are attacked by police dogs and swept off their feet by the blasts of firehoses. We are also familiar with the scenes from Selma, Alabama, and the violent confrontation between State Police and peaceful voting rights protestors on the Edmund Pettis Bridge on Bloody Sunday in Selma, Alabama. Therefore, Mobile is also not generally associated with major civil rights victories like the victory of the Montgomery Bus Boycott, or the victory to desegregate downtown Birmingham, or the coveted achievement of the Civil Rights Act of 1964, and the Voting Rights Act of 1965 after Bloody Sunday in Selma.

This study will present evidence that the boycott of the 1969 America Junior Miss Pageant organized by N.O.W. in Mobile, Alabama, did have its own share of confrontation, outside agitation, radical civil rights activists, dramatic protests, as well as positive results towards civil rights and racial progress. *Mentor: Mr. Derek Barry.*

## ***An OBHA-Like Result for Flexible-List Coloring*** **Yanghong Chi**

Mathematics is the universal language, studied to benefit humanity. It underpins advancements in spacecraft design, resource allocation, network routing, scheduling, and much more. Graph theory, one branch among many in mathematics, provides the abstract blueprint behind any network and routing systems used in modern society. In 2002, Ohba proved that  $\chi(G + Kn) = \chi \ell(G + Kn)$  for any graph  $G$  and sufficiently large  $n$ , where  $G + H$  denotes the join of  $G$  and  $H$ . With the introduction of flexible list coloring in 2019 (denoted as  $\chi \ell_{\text{flex}}(G)$ ), we must now find a proper  $L$ -coloring that satisfies the request  $r$  for an  $\epsilon$ -fraction of vertices, known as  $\epsilon$ -flexibility. Since  $\chi(G) \leq \chi \ell(G) \leq \chi \ell_{\text{flex}}(G)$ , it is natural to wonder whether the same result as in Ohba's theorem would hold if  $\chi \ell(G)$  is replaced with  $\chi \ell_{\text{flex}}(G)$ . *Mentor: Dr. Jeffrey Mudrock, University of South Alabama.*

## ***Performance and Security Efficiency Metrics Comparison Between Hybrid Encryption*** **Felix Cheng, Hector Whiston**

As the world quickly advances and pours more resources, time, and money into technology, it's important to think about the security of it all. Every day, people's personal data is uploaded and stored online. However, this comes with the risk of security breaches. Every day, security breaches can happen leaking personal info for everyone. As a response, many encryption algorithms were developed in order to protect sensitive data. This literature review aims to compare hybrids of many common algorithms. The ones this paper will look at are RSA + AES and RSA + ChaCha20. This paper was compiled from reviews of multiple articles that consist of similar topics. The conclusion will present clear results about which hybrid encryption is the most resourceful and fastest secure algorithm. *Mentor: Ms. Deb Gray.*

## ***The Restoration of the J.L. Bedsole Archives at The Mobile Medical Museum*** **Summer Davis, Cassandra Fleming, Conlan Gillespie**

The Mobile Medical Museum, founded in 1962 by Dr. Samuel Eichold II, contains a collection of medical artifacts that are over 300 years old, showing how healthcare has changed, scientifically and artistically, over time. The purpose of this project was to help the public learn about the museum while improving how its materials are



# ALABAMA SCHOOL OF MATHEMATICS AND SCIENCE

## 2026 SPRING RESEARCH FORUM

organized, preserved and accessed. This was done through general efforts to improve how archival materials are managed and treated. The project also included looking at the museum's website and suggesting ways it could be made more visually appealing and easier to use. Together, these efforts help protect the historical materials while making them more accessible and helping the museum become better known. *Mentor: Dr. Daryn Glassbrook, Mobile Medical Museum.*

### ***Read Between the Signs: Art and Semiotics*** **Abbigayle Armstrong, Chance Grant, Arian Sarhadi**

This study explores the relationship between quantitative and qualitative information in data visualizations. Can the understanding of quantitative data be influenced by qualitative design choices such as scale, color, composition, etc.? Do design parameters or other forms of bias in the creation of visual data manifest visual semiotic structures or meanings that can be formally analyzed or discussed? *Mentor: Mr. Orren Kickliter.*

### ***Solving Road Congestion: A New Driver Approach*** **Gabriel Asberry, Oliver Horn, Leo Xu**

Since the 19th century, the use and demand for motor vehicles has risen sharply. Along with this demand there are new problems, particularly traffic accidents and road congestion. The modern system of traffic lights is an integral part of society throughout the world as many countries use vehicles for transport of goods and people every day. And as the population grows, road congestion and traffic accidents are becoming an everyday part of life. In the US alone, drivers spend on average 63 hours more on the road due to road congestion. This project focuses on the human connection by engineering a new traffic communication system to alert drivers to upcoming traffic signal timing and prompt static drivers to avoid distractions which lead to phantom traffic. *Mentor: Dr. Elisa Rambo.*

### ***Three Sisters Rethought: An Analysis of the Micro-Nutritional Effects and Economic Implications of Indigenous-Based Companion Planting*** **Henry James Cook**

In exploring methods to reduce agricultural dependency on monoculture, extensive research on the viability of an Indigenous-style of polyculture referred to as Three Sisters' agriculture has been conducted, however, these prior investigations into the style's effects have been traditionally limited to analyses of nitrogen retention and yield rates. The object of my research is to yield a more comprehensive evaluation of the style's impact on the soil by investigating the effects it has on the soil's ability to retain certain micro-nutrients (i.e. potassium, calcium, phosphorus, et cetera) in comparison to traditional monoculture. The information introduced in this experiment was yielded from an experimental garden operated by myself, of which soil samples were gathered from and analyzed with a LaMotte Soil Kit. The information I collected denoted a noticeably higher rate of nutrient retention in the polyculture plot as compared to the monocultural plots. The key implication of this information is the potential macroeconomic cascade that the widespread adoption of polyculture could have: reducing the need for agricultural input, reducing the operating costs of farmers, and ultimately lowering the cost of consumer agricultural goods, all while providing for a reduction in agricultural environmental impact. *Mentors: Dr. Rebecca Domangue, Dr. Natalie Ortell.*



# ALABAMA SCHOOL OF MATHEMATICS AND SCIENCE 2026 SPRING RESEARCH FORUM

## ***Understanding and Addressing Anxiety of Robot-Assisted Surgery of Gastrointestinal Surgery Patients***

**Clyde Davis**

Candidates for robot-assisted surgery (RAS) historically have had unresolved misconceptions about surgical techniques used by robotic surgeons, often resulting in increased anxiety for a patient before surgery. This study analyzes how informational materials can improve patient understanding and decrease anxiety caused by robotically assisted procedures. The study consisted of three phases: First, a pre-intervention survey where patients were asked about their level of comfort and knowledge regarding robotic surgery. Then, an informational video was given to patients prior to seeing a physician that explained the risks and benefits of RAS. Immediately after, patients received the post-intervention survey, which included the same, shuffled questions as the pre-intervention survey. Both the intervention and surveys were administered through an electronic form. Preliminary data from 13 participants demonstrated significant improvements in perceptions and preferences following the video. The proportion of participants who preferred robotic surgery increased from 46.2% to 84.6%, while patient understanding of the benefits of robotic surgery (i.e., less pain and recovery time) improved from 53.8% to 92.3%. Additionally, average self-reported anxiety scores decreased by 1.38 points on a 10-point scale, a change consistent with clinical significance. Knowledge of how robotic surgery functions remained high before and after intervention (76.9%), indicating a strong baseline understanding. It's clear that after the survey, there was consistent improvement in knowledge, perception, and preference toward robotic surgery. In the future, a widespread professional patient intervention could be created to reduce anxiety and increase understanding of robotic surgery within all surgical patient populations. *Mentor: Dr. Kristen Wong, University of Alabama at Birmingham.*

## ***Viability of Solar Powered Delivery Vehicles in Suburban Environments***

**Ria Amtha, Amna Hadi, Elijah Morris, Nathan Thorjusen**

There is a great need for renewable energy to replace fossil fuels. Researchers set out to create a solar powered prototype that could one day aid in the design and understanding of electric-solar delivery vehicles. This project explores the efficiency of solar power in larger delivery methods as well as the viability of solar powered vehicles compared to their fossil fuel counterparts. The Engineering Design Process was used to design, build, and test prototypes of a solar powered delivery vehicle.

Researchers concluded that for larger delivery vehicles, an electric-solar hybrid design would be a more efficient and reliable solution than a purely solar powered design. Drawbacks of strictly solar powered vehicles include prices and efficiency of solar panels, and under some weather conditions, the motor did not perform optimally due to the lack of sunlight. An electric battery source as a backup energy source may resolve this issue. For smaller scale delivery, however, solar power is viable for delivering packages around a small community. The benefits include the reduction of greenhouse gas emissions and low operating costs over time. *Mentor: Ms. Helene Swanepoel.*