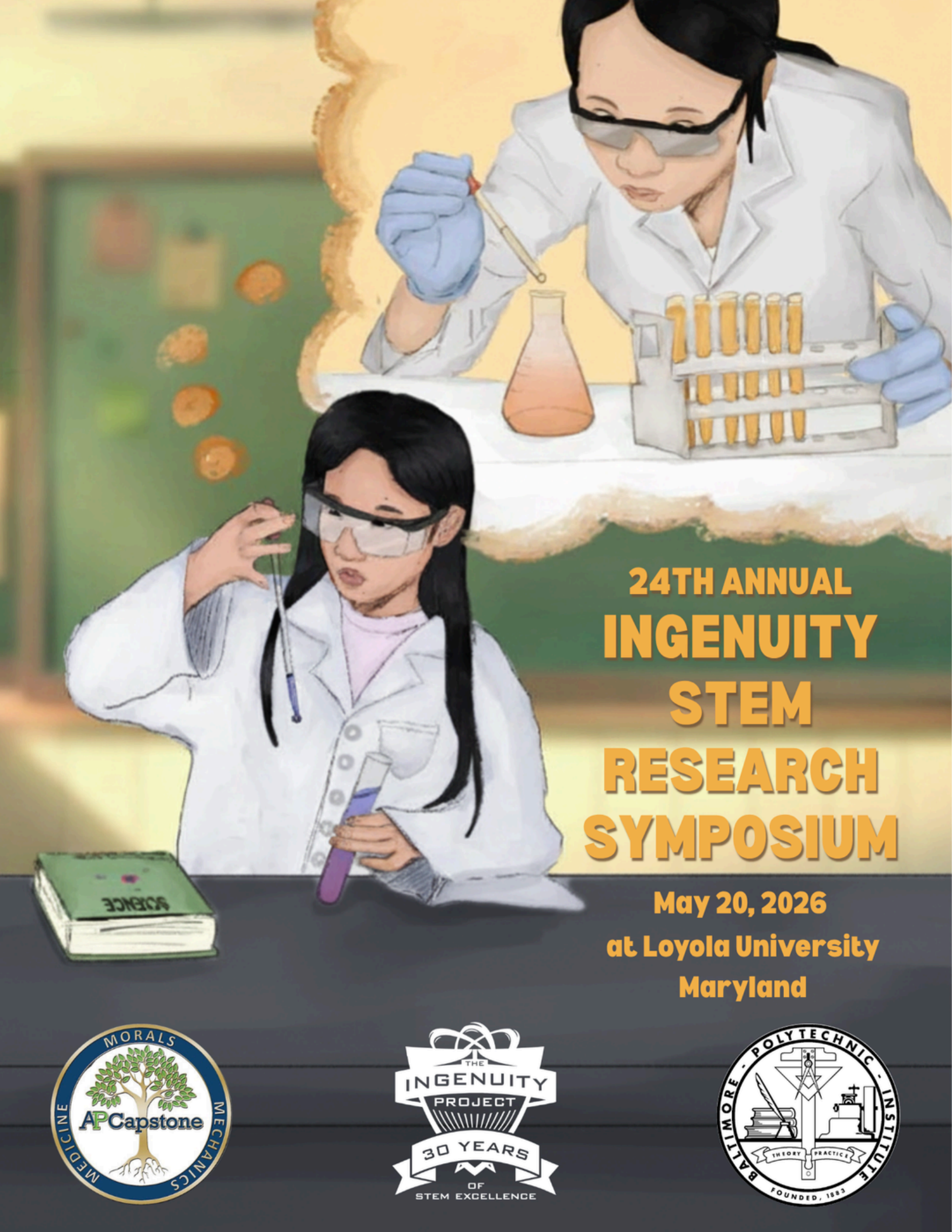

# 24TH ANNUAL INGENUITY STEM RESEARCH SYMPOSIUM

**May 20, 2026**
**at Loyola University Maryland**

MORALS · MECHANICS · MEDICINE
AP Capstone

THE INGENUITY PROJECT
30 YEARS OF STEM EXCELLENCE

BALTIMORE POLYTECHNIC INSTITUTE
THEORY PRACTICE
FOUNDED, 1883

# DEVELOPING LEADERS SINCE 1883

**Points of Poly Pride:**

- 2025 Maryland Blue Ribbon School
- Ranked in the top 2% of schools in the country by U.S. News and World Report
- 100% graduation rate for the class of 2025
- The class of 2025 received 1,713 acceptances to 289 colleges & universities (including Harvard, Brown, Duke, Johns Hopkins, Yale, Columbia, UPENN and the Naval Academy)
- 51 members of the class of 2025 are attending University of Maryland
- $48+ million in scholarships awarded to the class of 2025
- Over 48,000 hours of community service performed by the class of 2025
- Platinum level of recognition on the AP School Honor Roll
- 26 AP classes offered
- 90% of the class of 2025 took at least one AP course
- Over 1,900 AP exams taken by Poly scholars in 2025
- 2026 Robotics team participated in VEX Nationals in OH
- MD Green School
- Air Force JROTC won 2026 Baltimore CEO Cup for 10th year in a row
- Home of the John Clauser ‘60, winner of the 2022 Nobel Prize for Physics

These accomplishments do not happen by accident, and they are blind to zip codes and ethnicity. Excellence of this caliber is the result of the dedicated work of the school administration and faculty and the unwavering support of alumni and friends.

**The BPI Foundation & Alumni Association is a 501(c)(3) committed to providing Poly students with the high-quality STEM education they deserve and opportunities that are not found elsewhere. To learn more about how you can support the deserving scholars at Poly, please contact the Foundation & Alumni Association at 410-889-7659 or abrickhouse@bpi.edu.**

# 108 MIDDLE SCHOOLS, 37 ZIP CODES = 1 POLY

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# Dear Guests,

Welcome to the 2026 Student STEM Research Symposium, a premier showcase of inquiry and innovation hosted by The Ingenuity Project and the AP Capstone Program at Baltimore Polytechnic Institute. We are thrilled to have you join us as we celebrate the rigorous intellectual journeys undertaken by our student researchers this year.

This evening is a testament to more than just individual achievements; it is a celebration of a proud history. For over 100 years, Baltimore Polytechnic Institute has served as a forge for scientific excellence, maintaining a legacy of academic rigor that dates back to 1883. Building upon that foundation, The Ingenuity Project marks its 30th year of empowering Baltimore's high-potential students to push the boundaries of what is possible in STEM.

The Ingenuity Project and AP Capstone pathways provide students with rich, multifaceted ecosystems for discovery. These pathways ensure that Poly remains at the forefront of high school research, equipping the next generation to tackle the world's most pressing challenges.

We wish to express our deepest gratitude to our dedicated donors and families. Your steadfast support provides the resources and encouragement necessary for these young innovators to thrive. Without your commitment, the work you see tonight would not be possible.

Thank you for being here tonight. We invite you to engage with our students, ask questions, and witness firsthand the remarkable impact they are poised to make on the future of science and society.

Sincerely,

*Lisette S. Morris*
**Executive Director**
**The Ingenuity Project**

*Josh Headley*
**AP Capstone Coordinator**
**Baltimore Polytechnic Institute**

# Schedule of Events

4:30 - 5:50 pm Student Poster Viewing and Refreshments
6:00 - 6:50 pm Welcome, Alumni Panel, and Research Honoree Ceremony
7:00 - 8:20 pm Senior Ingenuity and AP Capstone Oral Presentations

**SENIOR INGENUITY & AP CAPSTONE RESEARCH ORAL PRESENTATIONS**

*Ingenuity Project - (ING), AP Capstone Research - (APC)*

7:00 - 7:18 pm

1. **Room 241 - Finnian Talbot** How Has the Improvement of Baseball Statistics and Data-Collection Methods Impacted the Game? (APC)
2. **Room 242 - Maelle Girard-Tsuru** Diversity of Shell-Forming Mechanisms Across the Tonian and Cryogenian (ING)
3. **Room 243 - Oscar Anaya** Artificial Intelligence Content Engagement and Accessibility (APC)
4. **Room 244 - Braylon Anderson** Soft Robot Catheter Stabilization for Endovascular Surgery (ING)
5. **Room 245 - Shanerah Wallace** Impact of Architecture on Sensory Comfort, Focus, and Wellbeing of Children (APC)
6. **Room 247 - Bianca Crainiceanu** Statistical Modeling and Neural Network Mediated Analysis for Microfluidic Device Videos (ING)

7:20 - 7:38 pm

1. **Room 241 - Luca Rodrigues** Sexual Dimorphism in the Orb Weaving Spider *Uloborus Diversus* (ING)
2. **Room 242 - Mikayla Maclin-Ray** The Development of Afro-Pessimism and the Impact on Black Expressionism in Modern Society (APC)
3. **Room 243 - Armin & Arman Ataei Kachoei** Utilizing Machine Learning to Calculate Tumor Volume Using IVIS Features (ING)
4. **Room 244 - Desire Coates** The Impact Internet Culture Has on Identity (APC)
5. **Room 245 - Thomas Lapp** Modifying the Acylation Selectivity of Erythromycin Using Metal Binding (ING)
6. **Room 247 - Sabrina Shi** The Effects of Lactylation-Mimetic k156q Mutation on cGAS-STING Protein's Autoimmune Signaling Function (APC)

# Schedule of Events

7:40 - 7:58 pm

1. **Room 241 - Gideon Emhoff** Methodology in Exoplanet Discovery from 1998 to 2025 (APC)
2. **Room 242 - Julia Crainiceanu** Assessing Gender and Racial Bias in GPT-4o-mini's Perception of Patients' Pain (ING)
3. **Room 243 - Ibeth Ruano-Hurtarte** The Impact of Trump's Racist Rhetoric Towards Latinx Youth (APC)
4. **Room 244 - Abdulla Ubaydullaev** Drag Forces on Wet-Flowable Substrates (ING)
5. **Room 245 - Benjamin Paglinauan-Warner** Treating High School Anxiety with the Ukulele (APC)
6. **Room 247 - Jerome Brown** Are Local Galaxies Cooling the Cosmic Microwave Background? (ING)

8:00 - 8:18 pm

1. **Room 241 - Marshall Civin** Understanding the Reaction Pathway in Cu-Ti Nanolaminates Using Differential Scanning Calorimetry (ING)
2. **Room 242 - Nevaeh King** How They See Us (APC)
3. **Room 243 - Khadim Fall** The Random Walk Hypothesis on Emerging and Developed Markets (ING)
4. **Room 244 - Aiden Bonicker** Measuring the Impact of Light Pollution on Astrophotograph Image Quality Using Signal-to-Noise Ratio Analysis (APC)
5. **Room 245 - Noah Carter** How SMBH Growth Affects the Host Galaxy (ING)
6. **Room 247 - Aria Harrell** The Heritability of Racism in Black Households (APC)

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# Ingenuity & Poly Alumni Panelists

A special thanks to our Ingenuity and Poly Alumni Panelists for sharing their STEM journeys.

## CAMILLE COFFEY

**Class of 2024**

- Dorsey Scholar at McDaniel College, Molecular and Cellular Biology Major
- At McDaniel, Historian of TriBeta, STEM Center Tutor, Teaching Assistant, and Student Coordinator of First Year Experience
- Completed Research Practicum in Department of Biology at Johns Hopkins University
- Current research in microbiology at Johns Hopkins School of Medicine

## EVAINS FRANCOIS

**Class of 2019**

- Civil Engineer Designer, Site Resources, Inc.
- Northwestern University, B.S. Civil Engineering
- Completed Research Practicum in the Department of Mechanical Engineering at Johns Hopkins Whiting School of Engineering
- Additional research on impact of riverbed mining on indigenous watershed in rural Ecuador

## FIONA QUIN ZABEL

**Class of 2020**

- Chemistry Ph.D. student at University of Connecticut
- University of Maryland, College Park, B.S. Chemistry and Environmental Science & Technology, Statistics Minor, Banneker-Key Scholar, Gemstone Honors Graduate
- Completed Research Practicum studying chemical contamination and social vulnerability at Johns Hopkins Bloomberg School of Public Health
- Currently researching drinking water in regions affected by kidney disease of unknown origin to identify potential chemical drivers

# 2026 Research Honorees

We celebrate the remarkable individuals who have significantly contributed to the success of Baltimore Polytechnic Institute's research programs through The Ingenuity Project. Their dedication to mentorship and education has empowered our students to excel in STEM fields, fostering a new generation of researchers and innovators.

## 2026 MENTORS OF THE YEAR

In appreciation of their outstanding mentorship

### DR. ANDREW GORDUS

Department of Biology, Johns Hopkins University

### DR. CLAIRE HUR

Department of Mechanical Engineering, Johns Hopkins University

### DR. CHEN LI

Department of Mechanical Engineering, Johns Hopkins University

### DR. DIVYA RAMESH

Department of Organismic and Evolutionary Biology, Harvard University

### DR. JUSTIN WEBSTER

Department of Mathematics and Statistics, University of Maryland, Baltimore County

## 2026 MATHEMATICS PARTNER OF THE YEAR

In appreciation of their ongoing contribution to mathematics learning and student success

# Ingenuity Math Scholars

The Ingenuity Project cultivates a passion for mathematics in its students, preparing them for success at the collegiate level and beyond. Ingenuity's curriculum and sequence is designed to equip students with a strong mathematical foundation and foster an appreciation for the beauty and challenge of problem-solving.

Ingenuity's Mathletics Leadership Cohort, led by Ms. Elisa No, provides students with opportunities to participate in math competitions outside the classroom to study difficult math problems and further their mathematical knowledge. This year's achievements include:

**American Mathematics Competition (AMC)**

The American Mathematics Competitions, provided by the Mathematical Association of America, are a series of exams and materials that build problem-solving skills and mathematical knowledge.

- **Participants:** Benjamin Grimaldi, Isaac Kamionkowski, Seeger Lefstein, Jerome Brown, Cullen Few, Michael Gapeev, Graham Gayler, Anjali Kane, Gabriel McMahon, Jakob Morales, Abdulla Ubaydullaev

**Clemson Calculus Challenge**

Ingenuity sponsored a trip to the 22nd annual Clemson Calculus Challenge on Friday, March 27, 2026, where high schools from various parts of the US gathered at Clemson University to solve extremely challenging Calculus problems both individually and as a team.

- **3rd Place, School Competition**
- **4th place, Graham Gayler**
- **4th place, Team Competition, Team 1:** Graham Gayler, Abdulla Ubaydullaev, Fan Lin, Cara Brunelle
- **Participants, Team Competition, Team 2:** Anjali Kane, Sokoro Lumumba, Joseph Horwitz, Mira Singh

**M3 Math Modeling Competition**

The M3 Modeling Competition challenges high school students to work in teams of 3-5 during a 14 hour time block to solve a real world math problem.

- **Team 1:** Abdulla Ubaydullaev, Jerome Brown, Thomas Lapp, Fan Lin, Andrew Gao
- **Team 2:** Jakob Morales, Winton Jones, Karun Pandian, Nico DePasquale, Sebastian Baylor

**COMAP Math Modeling Competition**

Like the M3 Modeling Competition, the COMAP Math Modeling Competition challenges students to work in teams of 3-4 to solve a real world math problem over a 2 week duration.

- **High School Math Modeling Competition, Team 1:** Abdulla Ubaydullaev, Jerome Brown, Thomas Lapp, Andrew Gao
- **Team 2:** Julia Crainiceanu, Marshall Civin, Colin Lilley, Gabriel McMahon
- **Team 3:** Seeger Lefstein, Benjamin Grimaldi, Rose Brown
- **Mathematical Contest in Modeling, Team 1:** Abdulla Ubaydullaev, Jerome Brown, Andrew Gao

**Maryland Math League**

- **One of the Top Scoring Schools, Cumulative**
- **Top Scorers at Poly:** Graham Gayler, Seeger Lefstein, Fan Lin, Joseph Horwitz, Morris Auerbach, Benjamin Grimaldi, James Ash, Marshall Civin, Bianca Crainiceanu, Thomas Lapp, Jakob Morales, Carter Pisano, Faiber Balanta, Gabriel McMahon, Michael Gapeev

# Ingenuity Research Scholars

Ingenuity has a longstanding history of students submitting to Regeneron Science Talent Search (STS) and The Morgan State University Science, Mathematics and Engineering Fair. Juniors and seniors participating in Ingenuity's Research Practicum as well as several freshman in Ingenuity's Biology class, participated in Morgan State's Science Fair this spring. This year's achievements include:

**The National STEM Festival**

- **National Champion, Marshall Civin** - Understanding the Reaction Pathway in Cu-Ti Nanolaminates Using Differential Scanning Calorimetry
- **National Champion, Bianca Crainiceanu** - Statistical and Neural Network Methods for Processing of High Speed Microfluidic Videos
- **National Champion, Kit Engelke** - Mapping Malaria Antibodies: Identifying Quality and Quantity of Malaria Specific Antibodies in Severe and Uncomplicated Malaria Case Presentations
- **National Champion, Thomas Lapp** - Modifying the Acylation Selectivity of Erythromycin Using Metal Binding
- **National Champion, Colin Lilley** - Auxin-Induced Degradation in *C. Elegans*: Tissue-Specific Effects on Benzimidazole Response

** All will be presenting their research in Washington, D.C. in June.*

**Johns Hopkins Mid-Atlantic Research Exchange (MATRX)**

- **Presenter, Natalie Huot** - Baseball: The Impact of Birthdays on Batting and Pitching Performance
- **Participant, Graham Gayler**

**Morgan State Science, Mathematics & Engineering Fair**

- **1st place, Maelle Girard-Tsuru, Earth & Environmental Science** - Diversity of Shell-Forming Mechanisms Across the Tonian and Cryogenian
- **2nd place, Thomas Lapp, Physical Science** - Modifying the Acylation Selectivity of Erythromycin Using Metal Binding
- **3rd place, Jerome Brown, Physical Science** - Are Local Galaxies Cooling the Cosmic Microwave Background?
- **3rd place, Jane Weiss and Kate Johnson-Carey, Teams** - Comparison of Calcofluor Staining Protocols to Identify Motile and Coccoid Stages of Symbiodiniaceae
- **Noah Carter, Honorable Mention, Physical Science** - How SMBH Growth Affects the Host Galaxy
- **Braylon Anderson, Honorable Mention, Engineering** - Stabilizing Soft Robotic Catheter to Treat Brain Aneurysms
- **Marshall Civin, Honorable Mention, Engineering** - Understanding the Reaction Pathway in Cu-Ti Nanolaminates Using Differential Scanning Calorimetry
- **Abdulla Ubaydullaev, Honorable Mention, Physical Science** - Drag Forces on Wet-Flowable Substrates


# INGENUITY SENIOR RESEARCH

**About Ingenuity Senior Research:**
The senior presentations represent the culmination of their research efforts. Students completing the Ingenuity Research Practicum worked with members of the scientific community during their junior year and the summer prior to their junior year. Each student has written a formal research paper detailing the results of their respective project. The papers were submitted to regional and national pre-college competitions, including Regeneron Science Talent Search (STS), the National STEM Festival, and Morgan State University Science, Mathematics & Engineering Fair.

*Reads left to right*
Top: Jerome Brown, Arman Ataei Kachoei, Armin Ataei Kachoei, Colin Lilley, Thomas Lapp, Khadim Fall
2nd row: Julia Crainiceanu, Bianca Crainiceanu, Alex Pietrzak, Marshall Civin, Abdulla Ubaydullaev
Bottom: Maelle Girard-Tsuru, Luca Rodrigues, Kit Engelke, Noah Carter

**Utilizing Machine Learning to Calculate Tumor Volume Using IVIS Features**

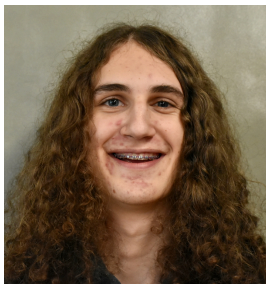
Arman Ataei Kachoei and Armin Ataei Kachoei
**Mentor:** Dr. Betty Tyler **Supervisor:** Dr. Ji Young Hwang
Department of Neurosurgery, Hunterian Laboratory, School of Medicine, Johns Hopkins University

Glioblastoma (GBM) is the most common and aggressive primary malignant brain tumor in adults, characterized by rapid growth, diffuse infiltration, and resistance to standard therapies. Due to its high mortality and limited treatment options, there is an urgent need for faster, more cost-effective preclinical methods to monitor the growth of brain tumors for drug testing. While MRI is the gold standard for volumetric assessment, it is costly, time-intensive, and low-throughput for longitudinal studies. In vivo bioluminescence imaging (IVIS) offers practical advantages, but the quantitative link between IVIS readouts and true tumor burden is not standardized or rigorously validated across commonly reported features. As a result, there is no accepted calibration framework to translate IVIS signals into reliable volume estimates that could meaningfully reduce reliance on MRI in preclinical drug efficacy studies. We evaluated whether IVIS can approximate tumor volume as an alternative to MRI. We computed MRI-based tumor volume via manual segmentation in 3D Slicer. Bioluminescence imaging was performed on luciferase-tagged tumors after luciferin injection, and radiance (photons/sec/cm^2/sr) was measured under standardized acquisition conditions. We quantified associations between IVIS bioluminescence features and MRI-calculated tumor volume. Minimum radiance showed the highest correlation (Pearson $r \approx 0.26$), indicating a weak but consistent relationship with volume. Accordingly, IVIS captures volume-related trends, yet is insufficient to substitute for MRI at present. These findings support integrating IVIS with computational modeling to lessen MRI frequency while retaining meaningful growth metrics. Future work will enlarge the dataset and assess vision-language models for volume prediction, aiming to release an open-source tool for community validation and refinement.

**Soft Robot Catheter Stabilization for Endovascular Surgery**

Braylon Anderson
**Mentor:** Dr. Jeremy Brown **Supervisor:** Noah Barnes
Department of Mechanical Engineering, Whiting School of Engineering, Johns Hopkins University

Brain aneurysms affect 1 in 50 people in the United States and 160 million worldwide. Upon rupture, more than 50% of victims die; survivors are left with disabilities. During minimally invasive treatment of aneurysms, a catheter is placed inside the blood vessels and artificially clots the aneurysm by delivering tightly packed coils, preventing further expansion and rupture. Steerable soft robotic catheters enable better control over the catheter's tip while inside the body; however, the catheter can still drift away from the aneurysm during treatment, preventing effective clotting. My contribution is a stabilization mechanism to allow fixing the position of the catheter tip during aneurysm treatment. I've designed the mechanism using SOLIDWORKS and 3D printing using a resin-based LCD printer. The mechanism is designed to expand when internal pressure increases, causing the chambers to bend, anchoring to the vessel walls, and deflating for easy removal. The device stabilizes the attached catheter, allowing it to treat the aneurysm. The first iteration included four hollow rectangular chambers, using two triangular notches each to promote bending. This prototype was too rigid and would often break over time. The second iteration used two hollow bellows structures as part of the chambers and the notches to induce better bending but to little avail. The latest iteration of the mechanism has the arms entirely made of bellows structure and overall streamlined the concepts of the previous designs. I have not obtained satisfactory results due to production setbacks. If successful, this design could improve the success of treatment.



**Are Local Galaxies Cooling the Cosmic Microwave Background?**

Jerome Brown
**Mentor:** Dr. Tobias Marriage **Supervisors:** John Appel, Carol Chan
Department of Physics and Astronomy, Krieger School of Arts and Sciences, Johns Hopkins University

This study investigates potential foreground contamination in the Cosmic Microwave Background (CMB), the light released 380,000 years after the Big Bang that serves as a critical tool for measuring fundamental properties of the universe. Luparello et al. (2023) reported systematic ~15μK CMB cooling around nearby galaxies, suggesting previously unidentified foreground contamination. This study independently verifies this detection and extends the analysis to individual Planck frequency maps. Using radial stacking of approximately 2,500 late-type spiral galaxies from the 2MASS Redshift Survey ($300 < cz < 4500$ km/s), a temperature decrement of ~13μK was confirmed. Null hypothesis testing with 1000 simulated CMB realizations confirms high statistical significance, with a $\chi^2$ of 119.4 compared to the expected 19.0 ± 6.2, a >4σ significance. Then, instead of using a pre-separated CMB map to estimate CMB temperature around the local galaxies, models for the CMB, synchrotron radiation, and thermal dust emission as a function of frequency were created, yielding a CMB cooling of -10.54 ± 6.76 μK. While consistent with the previous analysis, the significant error reflects systematic discrepancies between the data and model. These discrepancies may be decreased in future work by including additional emission components, such as molecular CO emission, bremsstrahlung (free-free) emission, and spinning dust emission.

**How Supermassive Black Hole Growth Affects the Host Galaxy**

Noah Carter
**Mentor:** Dr. Andreea Petric
Department of Physics and Astronomy, Space Telescope Science Institute, Johns Hopkins University

The universe has different types of galaxies, classified as active or inactive. These types have a centralized supermassive black hole (SMBH). However, they differentiate based on the black hole's accretion (growth). This accretion results in the output emissions from the region of the black hole (the active galactic nuclei [AGN]). These outputs include winds, jets, radiation, and luminosity. AGN feedback is how these outputs affect the surrounding interstellar medium. This research investigates how the accretion of the supermassive black hole affects AGN feedback and how it affects its host galaxy. This relationship was explored through photometry where data was sampled from images from the JWST Radio, X-ray catalog, and the Hubble Ultra Deep Field Observations. This data was used to determine the black hole accretion rate and the presence of AGN feedback. AGN feedback had a 0.259 correlation with black hole accretion, a 0.549 correlation with accretion efficiency (the amount of energy converted into radiation during the accretion process), and a 0.549 correlation with stellar mass (the total amount of contained matter within all stellar objects in the galaxy). Additionally, black hole accretion had a 0.304 correlation with stellar mass. This contributes to our understanding of galaxy evolution and the interconnection between some of the universe's natural properties. These results indicate that exterior factors play a more significant role in the composition of galaxies than was initially expected, which can be further explored in future experiments.

**Understanding the Reaction Pathway in Cu-Ti Nanolaminates Using Differential Scanning Calorimetry**

Marshall Civin
**Mentor:** Dr. Tim Weihs **Supervisor:** Dr. Rohit Berlia
Department of Materials Science and Engineering, Whiting School of Engineering, Johns Hopkins University

The study of Copper-Titanium (Cu-Ti) alloys is important because they replace a hazardous alloy, Copper-Beryllium, in applications where elevated mechanical strength and electrical conductivity are needed. To implement this transition, the mechanical and electrical properties and treatment of Cu-Ti alloys must be optimized. We analyzed the reaction pathways in Cu-Ti alloys using Differential Scanning Calorimetry (DSC), which provides kinetic and thermodynamic information about the samples being heated. This process allows us to determine the endothermic and exothermic reactions that create different crystalline and amorphous phases in Cu-Ti alloys. Next, we performed X-ray Diffraction (XRD) tests to analyze the phases that appeared. We found that α-Cu4Ti and β-Cu4Ti intermetallic phases formed. We concluded that there are proportional increases between the atomic weight percentage of Titanium and the amount of intermetallic Cu4Ti phase that forms. By using novel experimentation methods, we confirmed that DSC and XRD are viable to determine phase changes in Cu-Ti alloys. The optimization of these alloys has potential for increasing energy and cost efficiency for commercial Cu-Ti electrical wiring production.

**Statistical Modeling and Neural Network Mediated Analysis for Microfluidic Device Videos**

Bianca Crainiceanu
**Mentor:** Dr. Claire Hur **Supervisor:** Takayuki Suzuki
Department of Mechanical Engineering, Whiting School of Engineering, Johns Hopkins University

Image processing is a powerful tool for the automated processing of video data and has diverse applications. One application is analyzing high-speed videos of microfluidic devices for cell sorting, specifically intended for treating neurodegenerative eye conditions through cell therapy. In order to optimize a microfluidic device for cell sorting, high speed videos of different Induced Pluripotent Stem (iPS) differentiated cells injected through the device are obtained. The sorting capabilities of the device rely on different types of cells focusing on different lateral positions, which necessitates the classification and tracking of cells in the high speed videos. The cells in this project are both iPS differentiated cells that will be referred to as circular and spindle cells. In the pre-existing workflow, cell classification was done manually, and cell tracking was automated, but resource and time intensive. The workflow was redesigned using an automated segmentation algorithm to obtain geometric information, perform principal component analysis, and cluster data using K-means clustering. The system was then compared to the original workflow to check agreement in cell classification, obtaining an 87% accuracy in classification. This also created an objective classification of circular and spindle cells, which previously relied on judgment calls. To further the system, a proof of concept of using neural networks to segment cells to be able to track cells in the high speed videos and obtain a precise outline of the cell in the same step is needed.

**Assessing Gender and Racial Bias in GPT-4o-mini's Perception of Patients' Pain**

Julia Crainiceanu
**Mentor:** Dr. Axel Krieger **Supervisor:** Samuel Schmidgall, Dr. Lydia Al-Zogbi
Department of Mechanical Engineering, IMERSE Lab, Whiting School of Engineering, Johns Hopkins University

There has been an increasing interest in using Large Language Models (LLMs) — like OpenAI's GPT or Google's PaLM — in medicine. LLMs are already used in areas such as note-taking and summarizing, but new research has looked at the possibility of LLMs in areas such as diagnostic assistants with some already existing such as "Virtual Doctor: by custom GPT." From innovations such as these there stand to be benefits like increased accessibility across language, money, location, and amount of people. However, the high risk nature of medical work raises concerns over bias or inaccuracies. As these models are trained on the internet, there is concern over them perpetuating human bias. Building upon previous studies in assessing LLMs for medical racial and gender bias, I chose to assess GPT-4o-mini's racial and gender bias in the perception of patient's pain, an area that has historically been susceptible to such biases. GPT-4o-mini was asked to respond as to whether the pain reported by a patient was or was not exaggerated for different gender-race combinations. The results show some instances of gender bias and no difference across race. However, the most significant finding was how the wording of the question had a much larger effect than the patient's race and sex. The variability in responses for synonymous questions raises concerns over the validity of results and the usability of LLMs as a medical tool. As of now, I believe that more development is needed to safeguard LLMs for medical use.

**Mapping Malaria Antibodies: Identifying Quality and Quantity of Malaria Specific Antibodies in Severe and Uncomplicated Malaria Case Presentations**

Kit Engelke
**Mentor:** Dr. David Sullivan
Department of Molecular Microbiology and Immunology, Malaria Research Institute for Global Health, Bloomberg School of Public Health, Johns Hopkins University

Malaria is one of the most severe public health crises worldwide. This disease causes around 263 million cases and 600,000 deaths annually. The primary transmitter of malaria is the female *Anopheles* mosquito, which carries the parasite *P. falciparum* and transfers it into a human's bloodstream via bite. The two main species of malaria are *P. falciparum* and *P. vivax*, and these species can either cause severe malaria or mild (uncomplicated malaria). Proteins in the immune system called antibodies are what protect the body from parasites like *P. falciparum* from causing illness. This project investigated the difference in antibody quantity and quality between severe and uncomplicated cases of *P. falciparum*, *P. vivax*, and *P. malariae*. The method behind this experiment was a PEPperCHIP Immunoassay, the chip used in the immunoassay was an Infectious Disease Epitope Microarray Chip, and the avidity between the epitopes on the chip and antibodies in the plasma sample were analyzed. Thirteen unique samples were tested, and the hypothesis was disproved, showing different antibody quantity and quality for different microbial peptides. There were multiple examples of proteins that were particularly prevalent in high parasitemia or severe cases. In the future, these proteins will be further investigated and identified as potential vaccine candidates. Results from this experiment are important because they will add to the database and knowledge of how antibodies affect the severity of malaria infection as well as help vaccine research.

**The Random Walk Hypothesis on Emerging and Developed Markets**

Khadim Fall
**Mentor:** Dr. Jane Lincove
School of Public Policy, College of Arts, Humanities, and Social Sciences, University of Maryland, Baltimore County

The Stock Market is growing in popularity due to the potentially high returns and financial stability it offers. The daily behavior of market prices revealed that future stock prices cannot be predicted from past movements, so we worked to add to past information. In this paper, we analyzed the weekly returns of four U.S. Markets and one Brazilian Market to test for a random walk from February 12, 2014 to February 12, 2019. The indices were first tested using the Augmented Dickey-Fuller Test and the Variance Ratio Test, respectively, and then a model comparison test was conducted to compare ex post forecasts between a NAÏVE model and alternative forecasting models such as ARIMA, GARCH, and a Long Short-Term Memory (LSTM). We used several evaluation methods to assess our ex post forecasts, including RMSE and MAE. The variance ratio and ADF tests provided conclusive evidence that all the indices tested accepted the Random Walk Hypothesis, as did the forecasting models. This suggested a random market due to their failure to predict stock prices, as evidenced by constant differences in RMSE and MAE values. Future research could examine historical data to see whether the markets were not random at any point and offer a more thorough explanation.

**Diversity of Shell-Forming Mechanisms Across the Tonian and Cryogenian**

Maelle Girard-Tsuru
**Mentor:** Dr. Kelsey Moore **Supervisor:** Dr. Emily Smith
Department of Earth and Planetary Sciences, Krieger School of Arts and Sciences, Johns Hopkins University

The Neoproterozoic (1,000 to 538 Ma) was an important interval in Earth history during which major changes were occurring in the biosphere and the geosphere. A key event during this interval was the Cryogenian Snowball Earth event in which the Earth experienced two complete glaciations – the Sturtian (717 to 660 Ma) and the Marinoan (650 to 635 Ma). Between these glaciations was a global warming interval termed the Cryogenian non-glacial interlude. These vast environmental changes likely strongly impacted the biosphere, including eukaryotes, but it remains unclear to what degree and by what mechanisms. Key questions are: who were the major shell-forming organisms during the Cryogenian? And, did shell-forming mechanisms evolve across the Tonian and Cryogenian? Here we compare new and previously described fossils from the Cryogenian Ikiakpuk Group in Alaska (USA) to fossils from two Tonian deposits in Southern Kazakhstan, aiming to characterize shell formation in early eukaryotes before and after the glaciation. Using light-microscopy, scanning electron microscopy (SEM), and energy dispersive spectroscopy (EDS), we identify organisms that fit the characteristics of shell-forming and a variety of morphologies in the Cryogenian Ikiakpuk Formation. We then compare these to potential shell-forming organisms from the Tonian Chichkan Formation and the Dzhanytas Group, both in the Lesser Karatau Mountains of Kazakhstan. Our comparisons show if and how these mechanisms evolved across the Sturtian glaciation and build upon the diversity previously described to understand shell formation in early eukaryotes before and after the Sturtian glaciation.

**Modifying the Acylation Selectivity of Erythromycin With Metal Binding**

Thomas Lapp
**Mentor:** Dr. Nathaniel Garrison **Supervisor:** Dr. Thomas Lectka
Department of Chemistry, Krieger School of Arts and Sciences, Johns Hopkins University

Modifying the structure and site-selectivity of complex antibiotics is challenging due to their size and functional group density, often requiring highly engineered catalysts. However, metal binding has proven to be an effective tool for altering simple antibiotics. To further explore the potential of metal binding for the selective modification of larger, more complex antibiotics, the macrolide erythromycin was complexed with Zn(II), then acylated with various compounds. The dimethylamine of Erythromycin is known to cause autocatalytic synthesis of the adjacent 2'-hydroxyl. Hence, the site was suppressed by modifying the hydroxyl before complexation and acylation to prevent the formation of undesired products. Upon acylation, the site-selectivity of Erythromycin at the hydroxyls was successfully altered, creating higher yields of desirable acyl derivatives and an additional product. Metal-binding-induced effects, including charge repulsion, steric effects, and shifts in electron densities, likely resulted in the observed differences in selectivity. Overall, this complexation approach could be applied to further antibiotics, including similar macrolide derivatives of Erythromycin. Furthermore, complexation has proven to be a viable approach to modifying large antibiotics, with potential to be applied to the development of analogues with improved resistance. The exact location of the metal upon binding and characterization of each product formed is still being determined.

**Auxin-Induced Degradation in *C. Elegans*: Tissue-Specific Effects on Benzimidazole Response**

Colin Lilley
**Mentor:** Dr. Erik Andersen **Supervisor:** Dr. James Collins
Department of Biology, Krieger School of Arts and Sciences, Johns Hopkins University

Parasitic nematode infections pose a significant global health and economic burden to both humans and livestock. Anthelmintic drugs are used to combat these infections, but the arsenal of drugs is limited. Resistance to benzimidazoles (BZ), including the commonly used anthelmintic albendazole (ABZ), is widespread. Previous studies using the free-living model *Caenorhabditis elegans* to study BZ resistance have shown that loss-of-function mutations in the beta-tubulin gene ben-1 confer resistance. Complementary research has demonstrated that susceptibility to BZ can be conferred by overexpression of ben-1 in specific tissues. We examined the requirements for endogenous ben-1 expression to identify tissues in which ben-1 degradation confers resistance. To selectively induce ben-1 loss-of-function, we used the Auxin-Inducible Degron system (AID) to selectively degrade ben-1 through tissue-specific expression of the TIR1 F-box protein. Transgenic strains were generated with TIR1 expression in different tissues, including hypodermis, germline, intestine, muscle, pharynx, neurons, and pan-somatic. High-throughput development assays were performed to measure and compare the quantitative responses to ABZ between the different strains. Significant resistance to ABZ was observed in animals with degradation of ben-1 in neurons, comparable to the pan-somatic deletion. This result suggests that degradation of ben-1 in neurons was sufficient to confer the maximum level of resistance, and degradation in other tissues does not confer resistance. Further studies will test the role of ben-1 expression in specific classes of neurons which will help to identify resistance mechanisms. These results enhance our understanding of the modes of action regarding BZ drugs and provide new insights for developing treatments that target neurons and synergize with BZs to improve their efficacy.

**Partisan Bias and the U.S. Supreme Court: Examining Its Influence Across Case Types and Eras**

Alex Pietrzak

According to the Constitution's Framers, the Supreme Court Justices act impartially. However, with recent changes in the Supreme Court's composition and numerous controversial decisions, questions have arisen regarding impartiality, and some politicians have called for reform. This research examines how the influence of partisan bias on the Justices' decisions changes in politically divisive and non-politically divisive cases and analyzes changes in the influence of partisan bias over time. A statistical analysis was performed on Justices' voting coalitions in polarizing and non-polarizing cases. Voting patterns before and after 2003 were also compared. The results showed no statistical significance ($p$-value$>0.05$) in the influence of partisan bias between all politically divisive and non-politically divisive cases. However, there was statistical significance ($p$-value$<0.05$) in the influence of partisan bias between cases before and after 2003. Therefore, one can conclude that partisan bias historically had a similar influence in politically divisive and non-politically divisive cases, but this influence has increased in recent years, giving validity to reform options.

**Sexual Dimorphism in the Orb Weaving Spider *Uloborus Diversus***

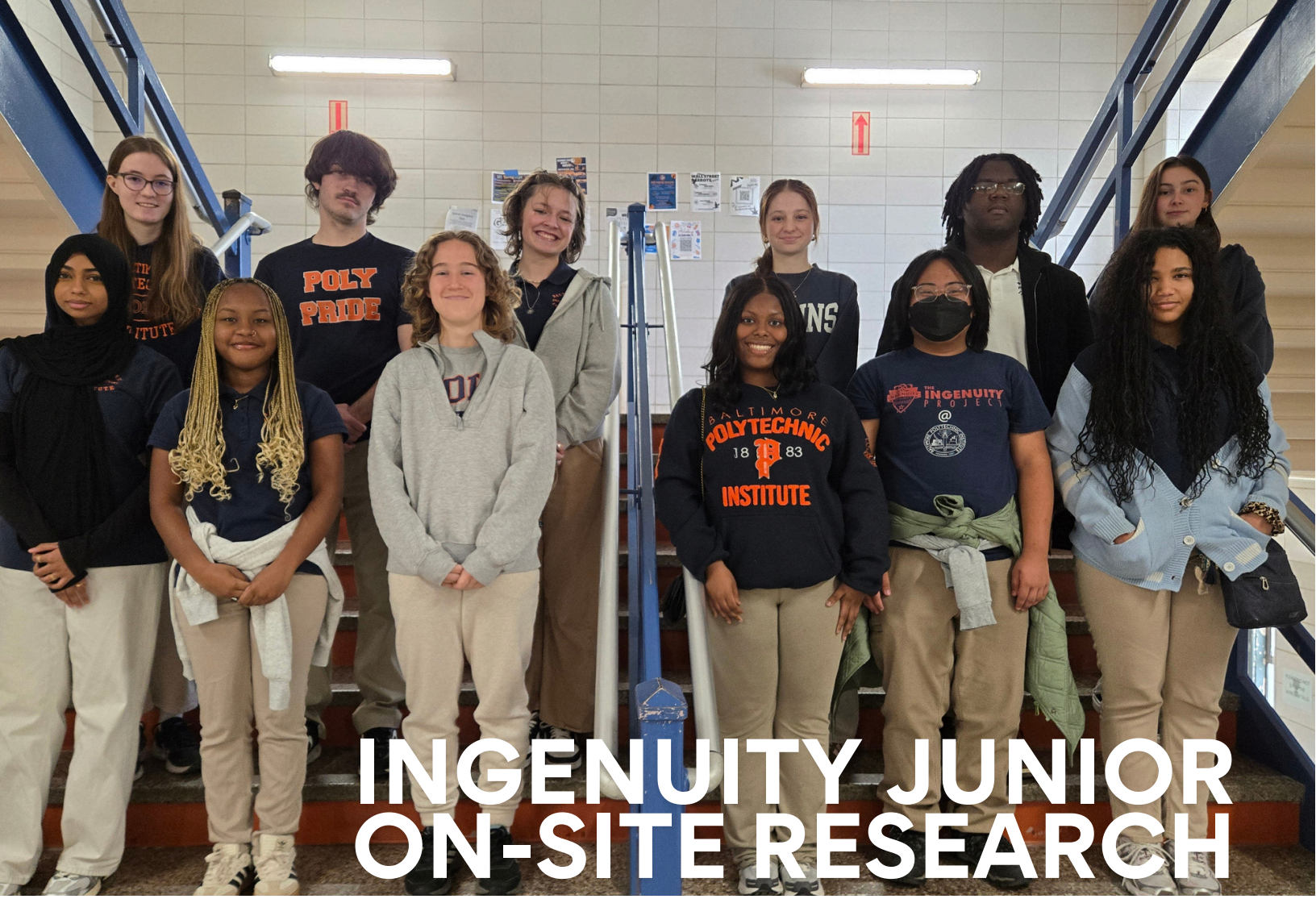
Luca Rodrigues
**Mentor:** Dr. Andrew Gordus **Supervisor:** Calvin Runnels, Dr. Hsin-Yi Hung
Department of Biology, Krieger School of Arts and Sciences, Johns Hopkins University

Sexual dimorphism is the difference in physical traits between organisms that have different sex. It has been studied extensively in humans and other model organisms such as *Drosophila* fruit flies, but because of its diversity, there are still many things that we do not know about how it works. In the spider *Uloborus diversus*, sexual dimorphism works a little differently than in well-studied organisms. This is because unlike humans and *Drosophila*, spiders do not have Y chromosomes. As a result, their sex is determined through X chromosome dosage, which complicates the process. The first step of researching this topic was to identify genes that may be significant to sexual dimorphism. To do this, RNA extractions were done and databases of genes that were found to be differentially spliced or expressed were compiled. Information in the database included generic information about the gene and GO annotations taken from *Drosophila*. For differential splicing, we identified whether the genes were transcription factors, and for differential expression, we recorded which sex the expression was increased in. Using these databases, we identified genes that are likely to have some role in sex determination. In the future, we will do experiments to investigate the specific functions of these genes.

**Drag Forces on Wet-Flowable Substrates**

Abdulla Ubaydullaev
**Mentor:** Dr. Chen Li **Supervisors:** Divya Ramesh, Gargi Sadalgekar, Daniel Collum
Department of Mechanical Engineering, Laboratory for Computational Sensing and Robotics, Whiting School of Engineering, Johns Hopkins University

Drag forces are integral components of locomotion in any medium and can provide key insights into strategies certain organisms employ. Such forces can be calculated through the Navier Stokes equations for swimmers in Newtonian fluids. Oftentimes, these equations must be solved numerically through heavy computation. However, in the case of non-Newtonian wet-flowable substrates, there are no fundamental force equations that can provide efficient means of calculation. Expanding on previous research, we propose that these force equations can be experimentally derived and efficiently calculated through the application of Resistive Force Theory. To test the variations of forces across different scenarios of interaction, we conducted experiments in a prepared and controlled mud environment and measured 2D drag forces experienced by a cylindrical probe with varying attack angles (with respect to velocity), depth, and mud volume fraction (clay wetness). Results from experiments have shown force magnitudes differ significantly with each parameter, with measurements reaching maximums at higher depths and mud volume fractions. For future work, these drag force measurements will be used to derive empirical formulas to model and predict the locomotion of various amphibious fish, such as the ropefish (*Erpetoichthys calabaricus*), including their robo-physical equivalents, in wet-flowable substrates.




# INGENUITY JUNIOR ON-SITE RESEARCH

**About Ingenuity On-Site Junior Research Practicum:**
As part of the Ingenuity On-Site Junior Research Practicum, students typically spend one summer and the academic year developing independent research projects. Working under the guidance of faculty advisors, on-site students have a high degree of autonomy in selecting their research questions, designing methodologies, and shaping the direction of their projects. Students take ownership of their full research process while drawing on in-house resources and the support of their advisors and mentors. ***A special thanks to all the advisors who offered their time and expertise throughout the school year.***

*Reads left to right*
Top: Natalie Huot, Carson Svoboda, Ella Hughes, Lily Sproge, Antonio Coates, Boudicea Cooney
Bottom: Zahraa Rimzan, Zoe Manning, Natalie Zakamska, Morgan Grayson, Aldrin Badiola, Alauna Davis

**Slime Molds as a Model of the Spread of Pathogens**

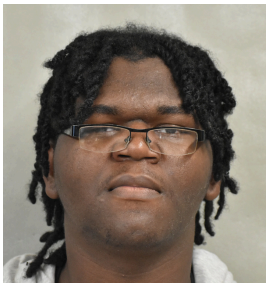
Erin Arcillo

Infectious diseases remain a global threat, especially in high-risk populations, as demonstrated by pandemics such as COVID-19. Because disease transmission is strongly influenced by population density and connectivity, it is critical to understand how transmission can be controlled, modeled, or mitigated. This project investigated the effectiveness of slime molds as a model for observing pathogen spread. Slime molds are single-celled organisms that form efficient networks similar to human contact systems and can be used to simulate how diseases may travel between populations. Three Didymium nigripes slime molds were grown using oats arranged in different patterns to represent varying population densities. Each setup differed in the distance between oats, which influenced the amount of slime mold coverage. Growth and movement were observed over time, and the rate at which slime molds reached each oat was compared across patterns. Results showed that slime molds in denser oat arrangements spread the fastest, followed by the medium-density setup, while the lowest density spread the slowest. These findings suggest slime molds can effectively model how disease transmission increases with population connectivity. This model provides a tangible way to visualize how network density influences outbreak speed. Future studies could simulate real city population densities to further evaluate transmission dynamics.

**Analyzing the Relationship Between Educational Outcomes and Economic Circumstances**

Aldrin Badiola
**Mentor:** Dr. Jane Lincove
School of Public Policy, University of Maryland, Baltimore County

Economic inequality has historically plagued the United States, especially in Maryland, where the structure of class has strong roots in racial discrimination. This study explores if modern day post-secondary educational outcomes of various regions in Maryland are related to their current economic circumstances, which could potentially show a modern impact of historical racism. Using linear regression, the percentage of students considered economically disadvantaged in a school by the Maryland State Department of Education (MSDE) was compared to the MSDE's Report Card Score for each school. In SY 2021/2022, the R-squared value was 0.538, SY 2022/2023's was 0.525, and SY 2023/2024's was 0.507. The p-values for each year were less than 0.05. These results provide enough evidence to show that a student's economic circumstances is a possible significant factor in predicting their educational outcomes. Future studies must analyze potential confounding variables (e.g. race and disability) and their impacts on the principal relationship between income and education, especially in different region scales, such as by ZIP code or by state.



**Application of Broken Window Theory: Correlation Between Vacant Buildings and Crime**

Antonio Coates
**Mentor:** Dr. James Foulds
Department of Information Systems, University of Maryland, Baltimore County

Baltimore City has some of the highest crime rates among U.S. cities, and anyone that has been there has seen the vast amount of ruined or abandoned buildings littering the streets everywhere. Both of these things might be correlated in some way that creates a cycle of one propagating the other, similar to the Broken Window Theory. The aim of this project is to find a correlation between the density of abandoned buildings and density of crime relative to the distance from the building. This was done using a kernel density model and data from openbaltimore, where data regarding arrests for various crimes as well as the location of vacant and reused buildings is localized within neighborhoods. The data was cleaned with an algorithm in the same environment as the kernel density model and compared to the data being run through predpol, a predictive model for crime in the form of a heat map on a managing app named Anaconda Navigator. The hypothesis behind the expected results of this experiment is that there is a positive correlation between crime and abandoned buildings, as abandoned buildings inspire crime, which most likely causes changes in the area's community and inhabitants and leads to more abandoned buildings, which creates a cycle. For future studies related to this subject, a causality study between abandoned buildings and crime is recommended.

**Effects of Microplastics on the Health of Common Deciduous Moss**

Boudicea Cooney

This study is focusing on the effect of microplastics (MPs) on the health of moss to better establish their viability as bio filters for removing MPs out of water. To find the effects of MPs on moss health, MPs were distributed to 50 samples of wild common variety moss in five groups, with amounts from 0, 0.25, 0.5, 1 and 5 grams. To measure the health of the moss, 0.5 gram amounts are extracted, cleaned in filtered water, crushed and dissolved in 80-90% acetone. The solution was then put into the spectrophotometer cuvette along with a cuvette filled with just water to be able to tare the machine to usher the clearest readings. The light absorbance was then taken with a light spectrophotometer to show the health of the moss samples. The results of this experiment show that the moss samples showed no change in health on average, except for the 5 gram samples, which showed a negative change. In conclusion, this experiment shows that moss can be reasonably used as a biofilter for MPs in wastewater. This establishment of an efficient biofilter is important because the less plastic in the water cycle, the less is consumed by people. MPs cause a bevy of health problems, and on average, adults consume about a credit card amount of MPs every week. The less consumed, the better.

**The Ecological Relationship Between Blue Crab and Invasive Blue Catfish in the Chesapeake Bay**

Alauna Davis
**Mentor:** Veronica Malabanan Lucchese
Institute of Marine and Environmental Technology

The Chesapeake Bay is the largest estuary in North America. It covers over 64,000 square miles and contains more than 150 streams and rivers which drain into the bay. Unfortunately, the health of the bay is at risk due to the numerous invasive species that have been introduced over the years. One such species is the blue catfish. These creatures make up a large portion of the fish population in the bay and often prey on native species and outcompete them for both habitat and food. This study revolves around creating an ecological food web that shows trophic interactions for blue catfish, blue crab, and marine populations in the Chesapeake. Through gut content analysis, a graph was formulated that shows the strength of relationships between various native species with a focus on blue crab and blue catfish. This data was analyzed using ecological network analysis packages in R studio. The results show that blue crab is the most influential species in the food web, with blue catfish and their connections also being highly influential. This shows how the blue catfish is infiltrating the Chesapeake food web and competing with blue crab for its prey species. Further analysis is needed to determine the negative impacts of blue catfish on blue crab. This study will not only inform policy makers and researchers but also fishermen and civilians who wish to help.

**Evaluating the Environmental Impact of Trash-to-Gas Systems on Rocket Fuel Emissions**

Morgan Grayson
**Mentor:** Dr. Anne Meier
Kennedy Space Center

As the distance increases in space exploration missions, the reduction of materials becomes even more important, since all items must be loaded on a single launch vehicle. With the help of NASA's Logistics Reduction and Repurposing (LRR) technologies, these missions can reuse, reduce, and recycle their trash into useful materials. Trash-to-Gas (TtG) technologies can turn waste into liquid methane to be used in place of other traditional fuels like hydrogen. This research aims to discover the advantages and disadvantages of using TtG liquid methane rather than liquid hydrogen and how the fuel impacts a long-term Mars mission. Data were collected using NASA article archives, including numerical and literature data used to compare the two fuel propellants. Through said articles, it was found that liquid hydrogen is extremely hard to store, especially in a typical 850-day mission. Liquid hydrogen has a low boiling point of -253°C and a low density of 71 kg/m³, which causes metal embrittlement and leakage and requires heavy insulation, active cooling, and power. Liquid methane, however, boils at -161.5°C, has a much lower boil-off, and can be stored passively for long durations, along with being created at Mars using the Sabieter Reaction. With this research, NASA or private space companies can begin to implement TtG technology in long-term NASA Mars missions.

**Trends and Patterns of School Shootings: A Nationwide Study**

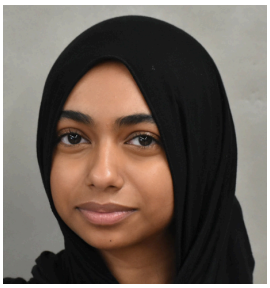
Ella Hughes and Zoe Manning
**Mentor:** Dr. Nicole Shoenberger
Department of Sociology, Loyola University Maryland

More than 390,000 students have experienced gun violence in school since 1999 in the United States of America. Perpetrators, who are often young white males, who may be mentally unstable, have access to a gun through legal purchase, illegal purchase, 3D printing, purchased kits, borrowing or stealing, which underscores the importance of credible background checks and firearm regulations. Easy access is a reason for gun violence, the #1 cause of death in children in the US. We used the public K-12 SSDB dataset, which focuses on school shootings and the demographics of those involved, and analyzed each data point in RStudio using descriptive and inferential statistics to conduct a correlational study and identify relationships among our variables. Exploring the relationship between school shooter demographics and school shootings will enable the pinpointing of correlations that local and federal governments can focus on to possibly reduce the amount of school shootings in the US. Our research questions are: How does a school shooter's school association (i.e., student, teacher, etc.) impact the number of victims injured during a school shooting? Are school shootings more likely to be targeted attacks? If so, who tends to be the target? How do the demographics of the school shooter change based on the school's level of education (i.e., elementary, middle, high school)? Raising awareness about school shootings and understanding the reasons for these events could inform policy making in federal and local governments regarding school shootings and other gun control measures.

**Baseball: The Impact of Birthdays on Batting and Pitching Performance**

Natalie Huot
**Mentor:** Dr. Anton Dahbura
Department of Computer Science, Whiting School of Engineering, Johns Hopkins University

Birthdays are special days in the year that can create either heightened positive or negative emotions. Previous research has shown that both emotions can have an effect on work performance for teachers and students. My research is focused on exploring the effect of emotions on baseball players by studying their performance on their birthdays from the 2010-2025 seasons. The data for this research was obtained from online sources such as Retrosheets and baseballr, an r package. Then, using the Rstudio platform, the data was filtered to only include players who played on their birthday. To get their performance from these games, the MLB-Stats API, an application programming interface, was used to generate data for the statistics of players on their birthday. By comparing this data to their season performance, a statistic called POB, standing for Performance on Birthday, was created by multiplying the difference in player's season and birthday statistics by their plate appearances. Preliminary results from my research show that the average POB value when considering wOBA(weighted On-Base Average) for batters was -0.894, showing that batters overall performed slightly worse on their birthdays. For the rest of my findings, it is predicted that the POB value will be relatively small and suggest only a slight relationship. This research may prove useful to sports organizations as to whether certain players should play on their birthdays, if they have a noticeably high or low POB, and will also shine more light on how mental health can impact athletes.



**The Influence of Particulate Matter (PM2.5) Emissions on Stomatal Functions Within Plants**

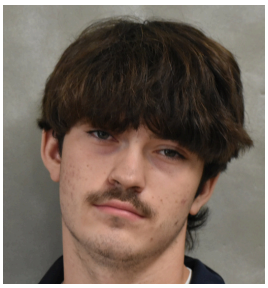
Zahraa Rimzan

Particulate matter (PM) is a major contributor to impairing stomatal function, reducing plant health and increasing overall air pollution. It can be found commonly within indoor and outdoor environments. Although extensive research has explored the human health impacts of PM2.5 exposure, there is much that remains to be understood about its effects on plants, our primary producers and essential sources of energy for life. This study aims to investigate the influence of PM pollution emitted from incense, specifically PM2.5, on plants with respect to variations in physical plant characteristics, such as stomatal shape, density, and size, along with trichome density and grooves. It was hypothesized that plant morphology would play a role in both reducing and increasing the amount of PM that accumulates on plants. Stomatal density may also be reduced due to their prioritization in self-defense. To compare the stomatal behavior, this study used four plants across two different species: one with dumbbell-shaped stomata and the other with kidney-shaped stomata. This experiment was conducted by placing two types of plants in acrylic glass chambers connected to an acrylic tube with burning incense in one chamber while the plants were in the other. For data analysis, t-tests were used to find the statistical significance between the two groups. ImageJ was used to measure stomatal data through microscopical images. The research findings intend to raise awareness of particulate matter's detrimental impact on plants, a critical concern frequently overshadowed by its notorious impact on humans.

**Social Conformity in Building Fires**

Lily Sproge
**Mentor:** Dr. Justin Bonny
Department of Psychology, Morgan State University

This research study examines how an individual's behavior in a building fire can be influenced or changed by the actions of others around them. The act of changing one's behavior to match others is known as social conformity, and it is typically seen when people conform to the majority. This conformity is believed to be caused by humans' innate desire to feel accepted and our fear of rejection, both of which stem from prehistoric times when humans were forced into groups to survive. Understanding how social conformity can change behavior in a fire situation is important to better understand and accommodate different evacuations and actions. To get results, we simulated fires on online servers using code to ensure participants experience no risks posed by a real fire. We presented participants with a fire situation in a food court, a randomized social situation, and questions asking them what their most likely course of action would be. We anticipated that each different social situation would have higher levels of conformity than non-conformity, but the weakest conformity would be in the “You stand and watch the fire, waiting for what will happen next” option. We anticipate that these findings will provide a clearer understanding of human behavior in fires and help experts design evacuation models with more accuracy and real-world results in mind. We recommend that future studies include more locations and variables to get a more accurate and realistic grasp of conformity in fires.



**How Does Mental Health Affect Recovery from Sports Injury?**

Carson Svoboda
**Mentor:** Dr. Ginger Yang
Abigail Wexner Research Institute, Nationwide Children's Hospital and The Ohio State University College of Medicine

Previous research suggests that mental health may influence injury recovery outcomes, however, the role of coping behaviors in both physical and psychological recovery remains unclear. This study examined the relationship between coping behaviors and recovery from sports injuries among Division I collegiate football athletes. Specifically, the study aimed to determine whether engaging in coping behaviors is associated with improved physical and psychological recovery outcomes following sports-related injuries. Data was analyzed from a large CDC-funded study involving 449 injured collegiate football athletes across three universities. Participants completed multiple surveys during their injury recovery period. In this study, coping was defined as responses to stress, including counseling and support-seeking behaviors. Recovery outcomes included self-reported physical recovery status and pain levels as well as psychological recovery measured by anxiety and depression scores. Independent t-tests were conducted to compare recovery outcomes between participants with higher versus lower coping scores (above or below 2.27). Results showed no statistically significant association between coping behaviors and physical recovery ($p = 0.9464$) or pain levels ($p = 0.8566$). These findings may be influenced by limitations in the dataset, including unequal sample sizes between counseling ($n = 33$) and non-counseling participants ($n = 206$), as well as variation in injury types. Overall, further research that accounts for injury type and other confounding factors is needed to better understand how coping behaviors affect recovery after sports injuries.

**Assessing Reuse of Dredged Material from In and Around Baltimore Harbor**

Natalie Zakamska
**Mentor:** Dr. Beth O'Shea
Department of Environmental and Ocean Sciences, College of Arts and Sciences, University of San Diego

Around 4.5 million cubic yards of sediment are dredged from Maryland waterways annually. Dredged material (DM) can be reused for purposes such as land amendment, but contamination prevents using sediments from some areas. Given the quantity of DM and limited storage capacity, we need to understand the risks of reusing DM to make use of this resource. This project analyzed the total concentrations of 4 metals (chromium, copper, manganese, and lead) in sediment samples from sites near Baltimore and simulated the release of metals from oxidized DM into rainwater. To evaluate contamination and risk, we used the geoaccumulation index (Igeo), mean effects range median quotients (mERMQ), and percent differences between experimental concentrations and screening values. We found most Curtis Bay and Inner Harbor sites had higher concentrations of Cr, Cu, and Pb than the main Chesapeake Bay. Igeo values showed moderate to strong Cr, Cu, and Pb contamination in most sites, while mERMQ values indicated ≥50% risk for most sites and >80% risk for the most contaminated site. Mn concentrations exceeded several guidelines despite being within natural ranges. A high Mn concentration in the deeper Chesapeake sample indicates that geochemical cycling may influence the contamination of DM. However, concentrations of Cr, Cu, and Pb were typically below EPA industrial RBCs and the ITRT non-residential reuse criteria by 50-100%, showing a possibility for industrial reuses. Future research should analyze the chemical changes of DM over time and the influence of other variables and exposure pathways on actual toxicity to organisms.


# INGENUITY JUNIOR OFF-SITE RESEARCH

**About Ingenuity Junior Off-Site Research:**
As part of the Ingenuity Junior Off-Site Research Practicum, students spend an academic year and two summers developing independent research projects under the guidance of mentors. Students in the off-site track conduct their research at university and professional labs under the mentorship of external scientists and researchers. These students are immersed in authentic research environments where they gain hands-on experience with advanced techniques, contribute to ongoing investigations, and learn the practices of professional scientific inquiry.

*Reads left to right*
Top: Khalil Thomas, Freeman Hatch, Winton Jones, Dominic DePasquale, Divine Stamper, Karun Pandian, Oliver Gospodarev
2nd Row: Kevin Woolford, Hajrah Refai, Elias Zisselsberger, Elliot Andersen, Kate Johnson-Carey, Jane Weiss, Isabelle Frias-Smith
3rd Row: Cullen Few, Phianna Koehn, James Vey, Grace Patmore, Lila Engelke, Ariel Shi, Jakob Morales
Bottom: Jorge Vasquez-Cordon, Ainsley Breidegam, Cecilia Soko, Sophia Sommer, Lexie Eblaghie, Hala Hassanein, Erin Arcillo

**The Development of a Connectome in *Uloborus Diversus* Using 3D Immunoflourescent Images**

Elliot Andersen
**Mentor:** Dr. Andrew Gordus
Department of Biology, Krieger School of Arts and Sciences, Johns Hopkins University

This work provides a detailed explanation of how spider neuroscience has advanced from brain imaging with filters of synapsin and betatubulin. Using these filters, we will be able to track more general neurons across the entire *Uloborus Diversus* brain. We use these *U. Diversus* spiders for a multitude of reasons, including the fact that these spiders are readily available from farms. *U. Diversus* also has no poison gland above its head, which makes it much easier to dissect the spiders and harvest their brains. These neurons provide a valuable resource to the scientific community, as these detailed annotations can show how different neuropils, large sections of a brain such as a human amygdala, connect throughout a spider's brain. Our ultimate goal is to have a connectome created such that we can track every neuron throughout the entire brain. This has never been done inside of a spider and will be an immense resource to neuroscience and scientific communities. In addition, it can continue research into the brains of spiders that have functions, such as web-building, that the scientific community does not understand.

**The Role of Double Zinc Fingers in the Nuclear Localization of Sall3**

Ainsley Breidegam
**Mentor:** Dr. Paul Welling **Supervisor:** Lauren Torres-Hernadez
Department of Physiology, School of Medicine, Johns Hopkins University

There are around 1 million nephrons within a kidney that are responsible for kidney function. The distal convoluted tubule (DCT), a part of the nephron, specifically, is responsible for sodium retention. Sall3 is a protein in the DCT. Sall3 is a transcription factor, meaning it regulates DNA. Due to this function, it has a process to enter the nucleus (nuclear localization). Sall3 lacks a nuclear localization signal, so it is still unknown on how it reaches the nucleus. We hypothesize that Sall3's double zinc fingers (DZF), parts of a gene that help attach one protein to another, are responsible for a binding process that brings Sall3 into the nucleus. This study aims to discover if DZFs are responsible for Sall3's nuclear localization. This was implemented through PCR mutations to Sall3's two DZFs, which were then analyzed by a transfection of plasmid to human embryonic kidney cells, nuclear and immunofluorescent staining, and microscopy analysis. Preliminary results include aggregates of Sall3 on the periphery of the nucleus in the mutated cells as well as Sall3 localized in the cytoplasm instead of the nucleus once a mutation was introduced. This suggests that DZFs could be part of what brings Sall3 to the nucleus. This could be scaled as this is an unknown area of study that could have larger impacts for understanding kidney function and preventing kidney disease, especially the DCT's role in salt retention and homeostasis.

**A Behavioral Assay to Quantify Human Odor and Heat Guided Host-Seeking in *Anopheles gambiae* Mosquitoes**

Dominic DePasquale
**Mentor:** Dr. Andrew Gordus
Department of Biology, Krieger School of Arts and Sciences, Johns Hopkins University

*Anopheles gambiae* mosquitoes have a preference for human hosts, and are the primary carrier of the malaria parasite, *Plasmodium falciparum*. *A. gambiae* selects its hosts primarily based on odor, which is made up of the chemical compounds produced by bacteria on the host's skin (skin microbiota/ microbiome). This study aims to help in identifying the primary chemical compounds that attract *A. gambiae* to human hosts by identifying highly attractive individuals and their respective skin microbiota. We accomplish this with an assay consisting of a heat-pad that emits CO2 and an air duct that blows odor from a human host over the heat-pad. Data is collected in the form of videos focusing on each heat-pad, which can show the frequency and total amount of mosquito landings. While the data gathered from this study alone will not identify which specific compounds attract *A. gambiae*, it will reveal which subjects are most attractive. This study can be repeated with those subjects, or subjects with very similar skin microbiomes, to get more particular results. Later, specific compound studies can be conducted to find the individual compounds that are most attractive. This data will assist in making more effective mosquito traps/repellents and identifying high-risk individuals.

**Understanding Accredited Social Health Activists' Interactions with Community Members, Healthcare Providers, and Local Government Institutions**

Lexie Eblaghie
**Mentor:** Dr. Svea Closser
Department of International Health, Bloomberg School of Public Health, Johns Hopkins University

India is home to one of the most extensive systems of community health workers in the world: nearly one million Accredited Social Health Activists (ASHAs). ASHAs are part of an all-female program of community health workers embedded on the village level as part of India's transition to a decentralized public health system—initially targeting nutrition and neonatal and maternal mortality— acting as middlemen between local governments, healthcare providers, and communities: the three main stakeholders. As the program has grown, discussion surrounding ASHAs' roles in the wider Indian public health system has increased. This study responds to the call for research on the social impacts of the system's decentralization and how dynamic interactions with the three stakeholders affect the performance and approaches of ASHA workers. In-depth interviews took place with ASHAs and the three stakeholders in two districts in India—Raichur and Chamarajanagar—and were transcribed and translated for analysis. Focusing on ASHA transcripts, qualitative data analysis was conducted using a priori coding in MAXQDA to look for ASHA attitudes towards work and characterization of the nature of their relationships with all other aforementioned stakeholders. Although findings varied, reoccurring themes included ASHAs being both scapegoats and trusted resources for a community, a lack of interaction between ASHAs and the Gram Panchayat (village-level governmental bodies), an ASHA's sense of duty to her community, and more complex interpersonal relationships with each stakeholder. As the ASHA program evolves, contextualizing them in the larger Indian public health system is essential for its improvement and implementation of future policies.

**A Tonian Hot Spring Ecosystem Preserved in the Chichkan Formation**

Lila Engelke
**Mentor:** Dr. Emmy Smith **Supervisors:** Caroline Newell, Lucy Helms, Dr. Kelsey Moore
Department of Earth and Planetary Sciences, Krieger School of Arts and Sciences, Johns Hopkins University

The Tonian Period is an era of time about 1000-720 million years ago and represents a key moment in evolution. Studying sedimentary rocks and fossils from this period helps scientists understand how life began turning from simple microbes to more complex organisms. While many studies have investigated the Tonian fossil record, they have mostly captured a snapshot of only shallow marine ecosystems. This means we have some gaps in our knowledge of other habitable environments that may have existed during this time. One way to fill in this missing information is to study microfossils that have been preserved in sedimentary rocks from environments that are non-marine. Microfossils are not visible to the human eye, so in order to see them, you have to use a specialized kind of microscope. Once able to see the microfossils, they can be analyzed by taking photos and recording observations. These observations can be used to make conclusions about whether this environment was made up of one ecosystem or if there were many different ecosystems that inhabited different parts of the hot spring system. Overall, this research has shown that there were multiple ecosystems that inhabited different parts of the hot spring system and that this ecosystem variability was dependent on the temperature and chemical conditions of different microenvironments.

**Modelling Glioblastoma with Immune-Vascularized Brain Organoids**

Cullen Few
**Mentor:** Dr. Jinchong Xu **Supervisors:** Xiangyu Liao, Kadia Lissit
Department of Neurology, School of Medicine, Johns Hopkins University

Glioblastoma is a highly deadly brain cancer, lethal in 12-18 months. The glioma cells it is composed of are able to form connections with healthy neurons similar to synapses and utilize input from glutamate receptors, effectively fueling their growth and hijacking the brain's microenvironment. This hijacking is what makes glioma near impossible to treat, since treatments carry risks of harming healthy brain tissue. In order to investigate glioblastoma, we need reliable models. However, models for any neurological disease cannot properly model the vascularization of the brain. To address this, we created Immune Vascularized Brain Organoids (iVBOs), which are a reliable and reproducible system with an environment similar to a fully grown human brain, containing structures comparable to the Blood Brain Barrier. We then co-cultured glioma aggregates with iVBOs to create GiVBOs (glioma-iVBOs). We later observed successful tumor invasion of the organoids and coexistence with microglial and vascular features. Following these new discoveries, we plan to establish new standards of monitoring tumor progression in GiVBOs. Namely, we will examine tumor interactions with the brain microenvironment, with synapses and healthy neurons, and with vascularization within the organoids. We wish to establish a standard of measurement for each of these key features across experiments and laboratories. Bringing iVBOs onto the field of therapeutic development will offer a new model closely translatable to a human brain, especially since it realistically simulates the brain microenvironment. Additionally, glioma shares molecular pathways and genes of interest with Alzheimer's that could serve as potential therapeutic targets for both.

**Defining the Role of Secreted Effector *Risk2* During Infection of Host Cell by Means of Arthropod Vector**

Isabelle Frias-Smith
**Mentor:** Dr. Oliver Voss
Department of Microbiology and Immunology, School of Medicine, University of Maryland

*Rickettsia* is an obligate intracellular genus of bacteria transmitted primarily through ticks, fleas, and louse, and it depends on the eukaryotic host cell structures to survive and can range in pathogenicity. Infection by pathogenic strains of *Rickettsia* can expose the victim to many high fatality rate diseases. The reason for the range in pathogenicity is unknown, but previous studies have identified a number of secreted effectors which are present in the pathogenic strains and may cause pathogenicity. One of these effectors is *Risk2*, a kinase, which edits proteins in order to initiate host cell takeover. My project aims to qualify the characteristics of the *Risk2* gene and its effect on pathogenicity. Three variables of the gene in *Rickettsia* are needed for comparison: WT, *Risk2* knockout, and *Risk2* overexpression. To manipulate the gene, *pRAMf plasmids* are mutated to include the *Risk2* gene for the overexpression and a *Risk2* gene that has undergone basepair mutation to deactivate the protein expression. These plasmids are transformed into *E. coli* cells, then grown to increase the plasmid quantity, and finally, reisolated in order to multiply the plasmid. The product reaches its final state and is transformed into *R. parkeri* cells. Comparing the resulting variables should clearly show the direct effects of the *Risk2* gene on the *Rickettsia* bacteria.

**Using Machine Learning with LEGOLAS to Improve Solar Cells with Material Discovery & ZnS1-xSex**

Oliver Gospodarev and Phianna Koehn
**Mentor:** Dr. Corey Oses **Supervisor:** Dr. Jiayue Hu
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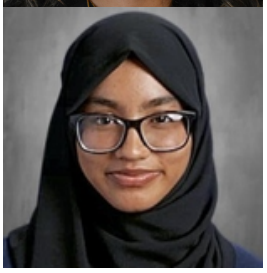
With global energy demand increasing and researchers exploring more sustainable energy alternatives, solar energy has become increasingly appealing as a clean, renewable energy source. Solar cells can harness the sun's energy by converting sunlight into electricity, making them an essential part of the development of a sustainable global society. While there are many types of solar cells, Dye-Sensitized Solar Cells (DSSCs) are a low-cost, environmentally friendly option for meeting this demand if they receive more development. A common way to improve solar cells is through material discovery, researching and applying new materials, and specifically semiconductors, where sunlight is converted into energy. To test Zinc Sulfur Selenium (ZnSSe) as a new semiconductor, solar cells with varying amounts of Sulfur (S) and Selenium (Se) were scanned by the LEGO-based Low-cost Autonomous Science (LEGOLAS) robot. Experiments like these require lots of time and money from researchers, but LEGOLAS uses machine learning to autonomously identify the relationship of S to Se to produce the optimal composite. After a composition was found, AFLOW, a framework for high-throughput computational materials discovery, was used to determine whether an approximate composition can be produced. In future studies, researchers could directly test the difference between DSSCs with ZnSSe, with its optimal composition, and DSSCs with Titanium Dioxide (TiO2), the traditional semiconductor used. Other studies in material discovery could also be conducted to continue the improvement of DSSCs. Studies could also focus on modifying LEGOLAS to be able to complete more tasks autonomously.



**Layer-By-Layer Polymeric Coatings and Mammalian Cell Growth: A Comparative Study of Counting Techniques**

Hala Hassanein and Hajrah Refai
**Mentor:** Dr. Jorge Almodovar **Supervisor:** Dr. Luis Carlos Pinzon Herrera
Department of Chemical, Biochemical and Environmental Engineering, Polymeric Biomaterials Lab, University of Maryland, Baltimore County

Cell culture plays an important role in biomedical research by enabling scientists to study diseases and develop treatments. Researchers must count cells reliably because accurate cell numbers are essential for measuring growth, viability, and treatment effectiveness. An approach for improving the controlled environment of mammalian cells is the layer-by-layer (LbL) technique, which coats cells with alternating polymer layers. This study examines the effects of polymeric coatings (heparin and collagen) on different mammalian cell types: human mesenchymal stem cells, human Schwann cells, and rat pheochromocytomas. The first step is to compare the accuracy of an automatic counter with manual counting methods across the cell lines. Cells were stained with trypan blue, loaded onto a hemocytometer, and counted manually using a microscope. Automated counts were obtained using the Countess™ II FL Automated Cell Counter. For each method and cell line, two trials were performed, and the results were analyzed statistically to identify trends. Manual counts between trials were generally consistent, whereas automated counts varied by several thousand to several hundred thousand cells. These discrepancies are due to lighting conditions and debris on the hemocytometer, which can interfere with the automated detection. Therefore, manual counting proved more reliable under the conditions used. Understanding the most accurate counting method is important before evaluating the effects of the coatings. It is expected that polymer-coated cells will exhibit enhanced viability and proliferation due to improved surface interactions and adhesion. Future research should optimize automated counting conditions, reduce variability, and further study polymer-coated cells to advance biomedical and tissue applications.

**How Reported Temperature Differences Vary Based on Local Conditions Vs a Neighborhood Scale**

Freeman Hatch
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The term “Urban Heat Island” (UHI) defines the phenomenon of urban areas being hotter than rural/suburban ones. UHIs are caused by heat trapping materials, a lack of vegetation, and little wind – all of which work to increase temperature, and are very common in urban environments. UHIs exist across the globe and can be a serious problem because of the risks that come with extreme heat (ex. heat stroke). To quantify these UHIs, temperature needs to be measured across cities. However, a big problem with this data collection is that local effects (shade, proximity to buildings) play a big role. This can change temperature readings so that stations will not give an accurate report. This study aims to explore the temperature fluctuations between two weather stations at Baltimore Polytechnic Institute that are 250 feet apart. One of these stations (Poly1) is in an exposed parking lot, and the other (Poly2) is in the school’s courtyard, making it much more sheltered from climate. Hourly data was collected from June 3rd to September 9th, which includes temperature, wind speed, and solar radiation. It was found that during early morning and evening, solar radiation differences explain most temperature differences between stations. However, during midday, wind speed differences explain most of these temperature differences. When solar differences are more important, Poly1 is hotter. When wind differences are more impactful, the more sheltered Poly2 is hotter. This data can be applied to stations/locations across the city to account for local siting effects.

**Comparison of Calcofluor Staining Protocols to Identify Motile and Coccoid Stages of Symbiodiniaceae**

Kate Johnson-Carey and Jane Weiss
**Mentor:** Dr. Allen Place **Supervisor:** Emily Jolly, Joanne Salzer
Institute of Marine and Environmental Technology

Symbiodiniaceae is a family of marine dinoflagellates, a single-celled eukaryotic algae that live in reef-building coral and provide nutrients that help them grow. This relationship creates the foundation of coral reef ecosystems, an essential part of our oceans. Symbiodiniaceae alternate between a motile (flagellated) stage and coccoid (non-motile) stage, the latter being the only stage they are able to reproduce in. This phase change is linked to stress response and bleaching in coral, which will be able to be recorded more precisely because of this study. Typical brightfield imaging on a microscope can be used to differentiate between the coccoid and motile stages but calcofluor staining is more distinctive. The calcofluor stains the thin armour-like structure in the cell called the thecal plate, which is only present in the motile stage. This study aims to find an efficient and accurate way to use calcofluor to image cells and distinguish between the two phases by comparing methods from previous studies and testing a multitude of protocols to find the clearest and most accurate imaging method. Initial results show that the optimized protocol produces the clearest images of stained cells and improves cell classification. This study will allow scientists to accurately and consistently identify cell life stages and will improve reliability in this area of research. Ultimately, such information can inform researchers as they work to ensure the health and viability of coral reef ecosystems.

**Impact of Cooling Methods on the Post-Fire Properties of Cold-Formed Steel**

Winton Jones
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In modern infrastructure, cold-formed steel (CFS) is commonly used for load-bearing structural members. This use of CFS is a relatively new advancement, so information on how it behaves in many situations is still lacking. The particular focus of this study is how well CFS retains its mechanical properties post-fire. Buildings catch fire often and due to various reasons, so it is essential to know how well their structural elements are able to withstand and survive these fires. Despite this variability, residual tests are scarce and of those conducted, solely have their specimens cooled in the air. This cooling method is not a realistic representation of how fire-exposed building components would cool and is the reason why this study endeavors to showcase multiple cooling methods, those being the aforementioned air cooling in addition to quenching and prolonged cooling. We used an MTS brand Universal Testing Machine combined with an extensometer to measure how much strength specimens had at failure and then compared these results and categorized them by cooling method. By looking at this data, predictive equations were developed/tested in order to better anticipate the strength of a CFS structural member in a post-fire scenario based on what type of cooling it underwent.

**Optimized Dark Matter Simulation Has Potential to Bring Insight On Its Unknown Properties**

Jakob Morales
**Mentor:** Dr. Marc Kamionowski
William H. Miller III Department of Physics and Astronomy, Bloomberg Center for Physics and Astronomy, Johns Hopkins University

The movement of galaxies could simply be caused by the gravitational pull of the visible mass in the galaxy, but that does not explain the speeds at which solar systems are able to rotate around the center of their respective galaxy. This discrepancy would imply the existence of a significant amount of mass that has not been detected, that is dark matter. Dark matter halos are an area that has a high density of dark matter that is held together by the gravitational pull of its constituents. The properties of dark matter are uncertain so various theories need to be developed and tested against observed data, one of which is the theory that dark matter decays. A decaying dark matter particle is characterized by its eventual decay, where it will lose some mass that is converted into kinetic energy, where its increased velocity is its kick. This type of dark matter will make the halo heat up from the increased kinetic energy of its particles, and if the kick velocity is high enough, the particles will escape the force of the halo causing it to dissipate over time. In order to study various theories of dark matter, a simulation has been developed that can be used to collect simulated data on various dark matter halos and how they change over time. Using the data collected on how the halo of decaying particles changes over time, we will compare the expected behavior of the halo with observed galactic movements.

**Investigating Disinfection Byproduct Formation Potential in the Stony Run through Chlorination of Samples**

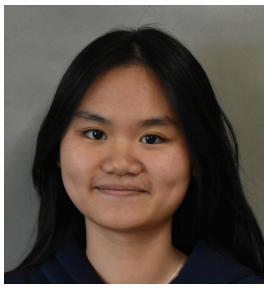
Karun Pandian
**Mentor:** Dr. Carsten Prasse **Supervisor:** Julian Maycock
Department of Environmental Health and Engineering, Prasse Lab, Bloomberg School of Public Health, Johns Hopkins University

When natural organic matter comes into contact with disinfectants like chlorine, bromine, or ozone, disinfection byproducts (DBPs) are created. These compounds have been repeatedly linked with negative health outcomes such as bladder cancer, miscarriage, and birth defects, as well as being cytotoxic, genotoxic, and mutagenic, which is why assessing their presence and abundance is extremely important. In the event of chemical spills or industrial runoff, large amounts of hazardous chemicals have the potential to be formed in a myriad of environments. This project focused on DBPs in the Stony Run, as there are many vectors by which streams can have environmental impacts. To simulate the conditions of a chemical spill, we chlorinated stream samples from two locations at 2, 10, and 20 mg/L for one hour, attempting to model different levels of exposure. Samples were then liquid-liquid extracted and run on a LECO Pegasus GC-HRT MS in electron ionization mode, using a non-targeted data analysis method. We predicted that increasing amounts of DBPs will be formed as free chlorine concentration increases but remain within regulations at 80 µg/L for total trihalomethanes and 60 µg/L for total haloacetic acids. Exact amounts of DBPs will be contextualized with total organic carbon and total nitrogen content, but we expected overall levels to be similar across both locations. Overall, these results should provide important information about the formation of DBPs in stream water, helping to plan for environmental crises in the future.

**Investigating Solar Flares on Solar Like Stars and Their Impacts**

Grace Patmore
**Mentor:** Dr. Rachel Osten
Space Telescope Science Institute

This study investigates the preliminary relationships between stellar effective temperature (Teff) and radius and data from Yang & Liu and Brasseur datasets were used. The stellar radii were determined by utilizing the Stefan-Boltzmann Law. This law relates a star's luminosity to its temperature and surface area. By rearranging the equation, the radius values were calculated from known temperature and luminosity. The resulting scatter plots from both data sets show a consistent inverse correlation between the temperature and the radius; cooler stars generally exhibit larger radii. In the Yang & Liu data set, the data follow a smooth continuous curve. The Brasseur dataset displayed a similar overall pattern but with a bit more variability and scatter, specifically around mid-range temperatures. The larger, cooler stars found in both data sets are consistent with later stages of stellar evolution. The agreement with both data sets strengthens the reliability of the observed trend. In the future, this study is going to be expanded by combining the observations of these datasets with observations of stellar flares from the same stars. This integration will allow for exploration of connections between temperature, stellar size, and flare activity. Through this study, we strengthen our understanding of how fundamental stellar properties like temperature and radius are related, providing insight into stellar structure.



**Natural Variation in *Caenorhabditis briggsae* Aggregation: PB420 Exhibits the Highest Aggregation**

Ariel Shi
**Mentor:** Dr. Erik Andersen **Supervisor:** Maya Mastronardo
Department of Biology, Andersen Lab, Krieger School of Arts and Sciences, John Hopkins University

Social aggregation in nematodes (roundworms) offers a valuable model for investigating how natural genetic variation influences behavior and adaptation. Nematodes provide a powerful model due to the genetic tractability, rapid life cycle, and conserved biological pathways, enabling researchers to link genomic variation to observable behavioral differences. While aggregation behavior has been extensively studied in *Caenorhabditis elegans*, in comparison, little is known about its closely genetically related species *Caenorhabditis briggsae*. Previous studies in *C. elegans* have identified key genes regulating aggregation, including npr-1, glb-5, and daf-7, but it remains unclear whether similar or distinct genetic mechanisms underlie aggregation in *C. briggsae*. This study aims to determine whether natural genomic variation contributes to differences in aggregation behavior in wild *C. briggsae* strains and how these patterns compare across the species. Hundreds of genetically distinct *C. briggsae* strains were grown under standard conditions to control environmental variables. Aggregation behavior was quantified using a plate-based behavioral assay. Adult worms were grown and imaged, and ImageJ software was used to record each individual worm's coordinates relative to distance from the food source and from other worms. These coordinates were compiled into spreadsheets and analyzed using RStudio to generate labeled graphs across four assays in order to visualize the distribution. Results from these analyses are currently in progress. This study hopes to reveal whether aggregation behavior in *C. briggsae* is influenced by an underlying genetic variation and whether species-specific genomic pathways regulate social behavior.

**The Change Of Fecundity of Roundworms Over Time**

Cecilia Soko
**Mentor:** Dr. Erik Andersen **Supervisor:** Dr. Nikita Jhaveri
Department of Biology, Andersen Lab, Krieger School of Arts and Sciences, Johns Hopkins University

In the world of biology, nematodes (roundworms) play a very crucial role as model organisms. They help scientists understand several processes within the body system, one being fecundity, which is the number of offspring they have throughout their life expectancy. *Caenorhabditis briggsae* (*C. briggsae*) are especially useful because they have a short life cycle, with a well mapped-out genome and can be easily grown in a laboratory environment. This study aims to identify which region of the genome is the cause of the difference in fecundity among several *C. briggsae* strains. Fecundity is measured by imaging the offspring made by individual worms and counting the number of offspring present on each plate. This happens over a course of 5 days (since they stop producing offspring after that). There are 366 wild *C. briggsae* strains. Their populations are synchronized to make sure that they are all at the same stages before analysis. The strains are divided into several assays that are genetically diverse with six strains to compare between each assay. Comparing the reproductive output across the strains, the research is seeking to determine which genome region is correlated with the difference in fecundity. If we can understand these differences, then we can potentially see into the world of how reproduction, fitness, and evolutionary adaptation are shaped by genetic variation.

**Metrology in Microscopy**

Sophia Sommer
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Microscopes are essential tools for discoveries on a scale invisible to the human eye. However, problems can occur and damages can negatively affect the hardware of these machines. This leads the instruments to damage over time without significant notice, and in turn, negatively impacts results. By testing each instrument, measures can be taken to improve the resolution and illumination stability to its theoretical state. Through the use of PSF (point spread function) beads, measuring resolution is achievable. Beads are prepared in a concentration that matches the field of view size and set onto slides. The beads are then imaged on the z-axis and the resolution can be measured through the intensity full width half maximum. Illumination stability is measured similarly through the use of fluorescent slides, and the standard deviation of the average intensity is calculated based on the inputted laser power. The data collected from this study shows an underlying amount of issues previously gone unnoticed. This includes a supermajority of instruments with lacking resolution and skewed field flatnesses. Keeping instruments in good condition is a common goal seen recently and gaining traction as set standards are in higher demand. This study seeks to encourage further corroboration in the scientific community by pointing out overlooked but substantial problems. Future research will be needed on objective and laser quality to better grasp causes and make these issues fixable.

**Using SimBa to Improve Behavioral Analysis in Rat Experiments**

Divine Stamper
**Mentor:** Dr. Donna Calu
Department of Neuroscience, School of Medicine, University of Maryland

This research project investigates the use of SimBa (Simple Behavioral Analysis), a machine learning-based software, to improve the efficiency and accuracy of behavioral analysis in scientific research. Traditional behavioral analysis relies on manually observing recorded experiments, which is time-consuming and can introduce human bias. This study asks: to what extent does SimBa improve the efficiency and reliability of analyzing rat behavior? To explore this, rats were recorded using cameras in controlled experimental conditions, and the resulting video data was prepared and analyzed using SimBa. Specific behaviors were manually labeled to train the software, allowing it to automatically detect and classify behaviors across recordings. Preliminary findings suggest that SimBa can successfully identify targeted behaviors while significantly reducing the time required for analysis compared to manual scoring. These results demonstrate the value of machine learning in behavioral research by increasing consistency, efficiency, and scalability. Overall, this project builds foundational skills in data analysis and highlights how technology enhances modern scientific research.

**How Mixed Linker Metal-Organic Frameworks Can be Used to Improve Lithium-Sulfur Battery Performance**

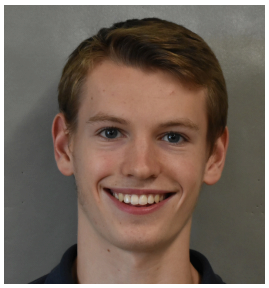
Khalil Thomas
**Mentor:** Dr. Sara Thoi **Supervisor:** Arleth Ortiz Villa
Department of Chemistry, Thoi Lab, Krieger School of Arts and Sciences, Johns Hopkins University

Replacing fossil fuels requires better energy storage than currently available. Renewable battery technology is the most promising alternative to fossil fuels. Lithium-Sulfur batteries hold the greatest potential to make it a reality. However, the main issue holding Lithium-Sulfur batteries from taking over the market is the polysulfide shuttling effect, the process of insoluble polysulfides building up on the anode, leading to rapid capacity decay and battery failure. Using Metal-Organic Frameworks (MOFs) to adsorb polysulfides has been extensively studied in battery science. It has been found that amine-functionalized versions regularly outperform their standard counterparts, but those versions clog pores and hinder their full adsorption capabilities. My project focuses on finding the optimal ratio of standard material linker to its amine counterpart to optimize polysulfide adsorption. I focused on materials MOF-801 and UiO-66, mixing regular linkers with amine linkers in ratios of 75:25, 50:50, and 25:75. To determine the superior mixture, battery cycling tests were used to find which material had the greatest capacity and could retain its capacity. The 75:25 mixture performed the best in both materials, having the highest capacity and retaining 10% more of its capacity for the majority of tests. This study shows the capabilities mixed linker MOFs have to advance renewable energy technology forward. Future research should focus on material characterization, such as Brunauer–Emmett–Teller (BET) and Thermogravimetric Analysis (TGA), along with mixed linker synthesis on other porous materials used in batteries, to see differences compared to their base and functionalized versions.

**Leveraging Deep Learning Protein Models for Zero-Shot Fitness Prediction in Enzyme Engineering**

Jorge Vasquez-Cordon
**Mentor:** Dr. Fátima Angélica Dávila Hernández **Supervisor:** Donovan Vincent
Department of Chemical & Biomolecular Engineering, The Gray Lab, Whiting School of Engineering, Johns Hopkins University

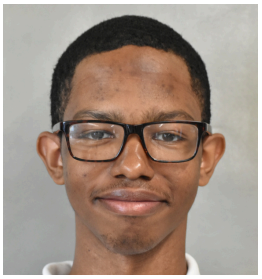
Plastic is widely recognized as a harmful pollutant to the environment, particularly the production of polyethylene terephthalate (PET), a common plastic found in packaging materials such as bottles and non-biogradable textiles. However, the discovery of PETase, an enzyme produced by the bacterium *Ideonella sakaiensis* capable of degrading PET, has opened new possibilities for mitigating plastic waste. Recent advances in computational enzymatic protein engineering can manipulate and improve the efficiency of PETase. This study examines how Deep Learning Protein Models (DLPMs) can be leveraged for fitness prediction in enzymatic engineering. Using zero-shot inference that is using models that evaluate PETase variants without task-specific retraining, I postulate that explicitly modeling different plastic ligands (PET and MHET) and protein structures with structure-aware scoring models will allow us to find candidates with good activity better than protein language models or random methods. I used Boltz2 to model the structures of different PETases in environments with PET and MHET. I then scored them using LigandMPNN and correlated different scores with their real activity labels. For comparison, I also used random scoring and scoring by protein language models that only use sequence information. It is anticipated that the LigandMPNN model will be the most accurate.



**Assessing the Accuracy of Computational Models for Damaged Wind Turbine Towers**

James Vey
**Mentor:** Dr. Benjamin Schafer **Supervisor:** Xi Peng
Department of Civil and Systems Engineering, Whiting School of Engineering, Johns Hopkins University

Wind turbines are becoming an increasingly popular form of energy around the world. This research focuses on the wind turbine tower, which is constructed from thin-walled steel tubes. While these towers are strong, they are severely weakened when any dents, called imperfections, are formed. After imperfections form, engineers use computational models to estimate the force the tower can withstand, telling them whether remediation or deconstruction is required. To mimic the towers, we used ten smaller thin-walled tubes with imperfections. We made two types of models for each specimen: a less precise model created using hand measurements and an exact replica of the specimen created using a laser scanner. We then inflicted both types of models with a compressive force using a computer program called ABAQUS, tracking the maximum compressive load at failure. What was found was that the hand measurement models were not very comparable to the laser scanned models, likely because the hand measurements could not model the minute imperfections that were accurately modeled in the fine mesh. We then compressed the physical tube specimens in the lab using a testing rig, again tracking the maximum compressive load at failure. Likely, the computational models using the laser-scanned data will be very similar to the physical compression, since they very accurately model the imperfections in the tube. What all of this shows is that the scanned data is preferred for modeling wind turbine towers and can be trusted to generate a good predictive model of the tower.



**Comparing Wet Bulb Globe Temperature & Other Heat Measurements at Nearby Weather Stations at Baltimore Polytechnic Institute**

Kevin Woolford
**Mentor:** Dr. Darryn Waugh
Department of Earth and Planetary Sciences, Krieger School of Arts and Sciences, Johns Hopkins University

Urban heat islands (UHIs) are a phenomenon where heat is stored in non-permeable areas during the day and is released during the night, which causes the area to be hotter at night. Studying UHIs is important because it creates an unsafe environment for everyone, regardless of age, due to higher temperatures and humidity during nighttime. This research aims to find the difference in temperature, heat index, and Wet Bulb Globe Temperature (WBGT). WBGT is a composite measure of heat stress that accounts for temperature, humidity, wind, and solar radiation to assess how hot it feels to the human body. For this study, one weather station was placed in the student parking lot near the interstate, while the other station was placed in a green space on campus. Data was collected over four months at set times. This research highlights how micro-environments within the same urban footprint significantly influence thermal comfort and heat retention. While both stations are roughly 250 ft. apart, they recorded different WBGT values during the afternoon. Underlying drivers of UHI, such as solar radiation in the parking lot versus humidity in the quad, varied based on site characteristics. This data confirms that proximity alone does not guarantee identical thermal experiences. Strategic placement of vegetation and management of permeable surfaces are vital tools in cooling urban environments and protecting public health from the effects of UHIs and how it endangers people's lives regardless of background.

**Identifying New Germ Granule mRNAs Affecting Germ Cell Migration**

Elias Zisselsberger
**Mentor:** Dr. Tatjana Trcek
Department of Biology, Krieger School of Arts and Sciences, Johns Hopkins University

Germ cells are cells which hold genetic information and pass it on when reproduction occurs. Germ cells are composed of germ granules which help to allow the cell to develop. Germ granules are an organelle made up of mRNAs and proteins. Additionally, cells that become germ cells first form in the germ plasm, which is located at the posterior of an embryo in an organism. In this study, we are trying to understand how some of these mRNAs affect the development of the germ cells. We completed Single-Molecule In Situ Hybridization (smFISH) to mark *Drosophila melanogaster* embryos with fluorescence so that the mRNA could be viewed under a microscope. Images were taken on the microscope, analyzed using MATLAB, and data was organized with Excel. If an mRNA shows clustering in the germ plasm, smFISH needs to be done for that mRNA again. However, this time it needs to be done on embryos that are mutated to not have a germ plasm to ensure a germ granule association. Lastly, RNA knockdown needs to be completed, which will remove the mRNAs from fly embryos in order to see what phenotypic (physical) effects there are on the development of the germ cells. The mRNAs, crq, DOME, and Sema-2a were observed and data revealed that Sema-2a could have an association with germ granules. Further experiments will be performed, however, I predict that Sema-2a could have an effect on germ cell migration. Future research should consider observing other mRNAs that may affect germ cell development.

THE INGENUITY PROJECT
30 YEARS
OF STEM EXCELLENCE




# INGENUITY SOPHOMORE INTRO TO RESEARCH

**About Ingenuity Sophomore Introduction to Research Class:** Sophomore students selected a social problem and explored how it connects to a STEM field through guided research. They gathered information from credible sources and used that research to explain the issue and possible STEM-based approaches to addressing it. Students worked with peers to share ideas, ask questions, and improve their understanding throughout the process. This project highlighted that science is collaborative and that strong ideas grow through discussion, feedback, and shared thinking.

# Sophomore Social Responsibility Projects

***How do invasive species impact ecosystems and biodiversity?***
**Animal Sciences:** Liliana Agnes, Grace Liu, Eddy Mei
**Biology:** Edalia Campbell-Harrison, Isaac Dvoskin, Trez Munroe, Prayash Sunuwar
**Math / Statistics:** Milo Evans, Zaina Shah, Camden Teeple
**Environmental Sciences:** Ziva Abel-Skinner, Sarah Barbour, Henry Caldwell, Daryn Ross

***What are the impacts of traffic and car accidents on individuals, communities, and infrastructure?***
**Computer Science:** Ella Franklin, Alexander Hoffmann, Calder La Follette Huck, Madison McGann
**Engineering:** Nasir Brown, Iyana Johnson, Evan Mosier, Zephaniah Noor
**Math / Statistics:** Ian Dickensheets, Kymoni Nicholson, Shanti Powell
**Public Health:** Christtian Carbajal, Jonas Frantz, Max Freeman, Alexander Gao

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***How does crime affect communities and shape social and economic conditions?***
**Biology:** Mohamed Diallo, Emile Girard-Tsuru, Aidan Pittman, William Warner
**Engineering:** Daxton Abel-Skinner, Jurian Holtz, Stephen Rueda
**Math / Statistics:** Amari Afolayan, Jayden Johnson, Mi'onte McGhee, Urum Okiyi

***How do invasive species impact the natural world?***
**Biology / Earth Science:** Audrey Myers, Reuben Pousson, Payton Saunders, MacKenzie Shea
**Math /Statistics:** Michael Gapeev, Graham Gayler, Phoenix Mohapatra

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***How do social media and peer pressure impact individuals and overall quality of life?***
**Computer Science:** Beckett Berberich, Vasyl Dail, Luke Parker, Rabi Rajak
**Psychology / Neuroscience:** Victoria Chambers, Wyatt Kovacs, Esmeralda Maya Toribio, Adaeze Okeke, Claire Potts

***How does water quality influence ecosystems and human health?***
**Biology:** Jonathan Allen, Ray Goldrick, Sarah Lincove, Avery Pisano
**Chemistry:** Kevin Hill, Roman Pietrzak, Mira Singh, Bridgette Story, Pryce Washington
**Earth / Animal Sciences:** Adelaide Fisher, Harrison Hubbard, Maxwell La Follette Huck, Dunia Ramadhan, Kenley Ravenna
**Engineering:** Hammond Broiles, Steven England, Finnian Glaros, Jack Johnson, Sterling Norris
**Math / Statistics:** Apollos Abdul-Wahhab, Yahia Hassanein, Uriah Nelson, Ruby Stewart-Smith, William Venuti


# AP CAPSTONE SENIOR RESEARCH

**About Advanced Placement (AP) Capstone Research:**
In its ninth year at Poly, the AP Capstone Research Program is serving 120 students in grades 10 through 12. The program's focus is on facilitating process-driven academic research outside of the laboratory. Students begin in 10th grade (Introduction to Research Methods) with a combination of textual analysis, analysis, and synthesis skills. In 11th grade (AP Seminar), students complete 3 papers to support an academic argument. Lastly, in 12th grade (AP Research), students conduct original research studies on topics of their own choosing. The goal is to increase student access to an academic research program and expand access to advanced academic opportunities for the betterment of the entire school community.

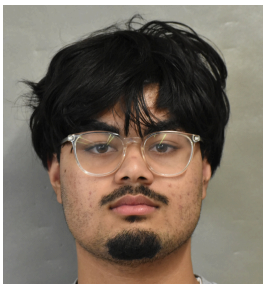
*Reads left to right*
Top: Damia Person, Aria Harrell, Desire Coates, Anthony Curtis, McKinley Curry, Malaya Victor
2nd row: Max Surkan, Oscar Anaya, Camari Drake, Christopher Williams, Ma'Kele Hill, Laiba Butt
3rd row: Fernando Gonzalez, Phineas Caiola, Chinzere Wright, Kaden Thomas, Marisa Coleman, Shanerah Wallace
4th row: Finnian Talbot, William Rousos, Maziyah Nolan, Genesis Canton Majano
5th row: Benjamin Paglinauan-Warner, Paul Bishwakarma, Chelsea Zellous, Victoria Moffatt, Ibeth Ruano-Hurtarte, De'asia Bradley, Nazmin Hosein
6th row: Ja'shawna Taylor, Gavriel Josiah Amper, Gideon Emhoff, Laylaa Long, Jada Turner, Makayla Edwards
Bottom: Genesis Martinez, Nevaeh King, Nadia Robinson, Carley Layton, Heroine Guedjou, Mikayla Maclin-Ray, Janiyah Chambers

**Artificial Intelligence Content Engagement and Accessibility**
Oscar Anaya

This study examines the influence of Artificial Intelligence, specifically AI-generated content, on social media platforms, particularly among teenagers and young adults. The purpose of this research is to better understand the ethical dilemma that the newer generation is facing. AI content has been made available in social media platforms and accessible to anyone with an account on any of the popular apps, including Instagram, TikTok, X (formerly Twitter), YouTube, Google, Snapchat, and other applications. Through an observational study of one month of popular applications such as Instagram and TikTok, data was collected by tracking and categorizing the types of content encountered. The findings reveal that AI-generated media is highly accessible, widely shared among others, and increasingly appearing in everyday modern technology. Algorithms based on user preference or account user profile, especially age, significantly shape the type of content displayed, reinforcing the idea of patterns of engagement and exposure to AI-related content appearing more often for a user. From a teenager's perspective, AI content is often viewed as both entertaining and engaging. Concerns for the prevalence of AI-content on social media include misinformation, ethical dilemmas, and the potential for future negative influence on users. While AI is continuously contributing to creativity and innovation, its increasing prevalence raises potential questions about responsibility, regulation, and digital knowledge moving forward. Limitations of this research include the lack of an extended time period, which might have made results more correlated. Another limitation is bias because there is no opinion other than my own. Future research should consider these limitations and include diverse opinions.

**The Impact of Financial Literacy Education in High Schools: Preparing Students for Life Beyond the Classroom**
Jy'Kira Battle

This study investigates how both high school students and teachers perceive the teaching of life skills, specifically financial literacy, including budgeting, saving, credit and taxes. The purpose of this research is to understand whether schools are preparing students for adulthood. For this study, a mixed method approach was used. A survey was conducted with 31 participants, which included 24 students and 7 teachers. Questions were asked about what life skills students learn in school, from where they learn the most to if teachers believe schools are preparing students for real life beyond the classroom. This included both multiple-choice and free-response questions that were used to get a variety of different opinions/perspectives. Survey results indicated that most students, 66.7%, feel somewhat prepared for adulthood after graduating high school, while 41.7% reported that schools do not teach financial literacy. However, 91.7% of participants believe financial literacy should be a required subject. Students reported learning most skills outside of school through self-teaching and expressed that hands-on learning opportunities would be very beneficial. Teachers also reported that not only do they struggle with these skills themselves but also have seen students struggling with these skills after graduation. Overall, findings suggest a gap between the curriculum schools teach and the life skills students need in order to succeed in adulthood. While students often learn life skills informally (outside of school and through self-teaching), incorporating structured financial literacy courses could make the transition after graduation less stressful, allowing students to be self-confident when handling money.



**To What Extent Does Employee Happiness Affect Job Performance Among High School Workers in the Baltimore Metropolitan Area?**

Paul Bishwakarma

This study explores the relationship between employee happiness and its correlation with job performance for teenagers in the Greater Baltimore Metropolitan Area. The purpose of this research was to understand and add onto the growing field of employee efficiency. Looking at teenagers in this study was especially important because there wasn't any deeper insight to see how people just getting started into the work force reacted differently to being happy from people already established. This was an important distinction to make due to the fact that young workers are inherently different from older workers, due to factors like age, brain development, and financial need. To gather my research, I sought out teenage workers to do a Google Forms survey that was used to collect quantitative data on employee happiness and its impact on job performance and daily life. Overall, I managed to gather 25 respondents where I concluded that happiness has a positive impact on performance. Out of the 25 respondents, 24 said that being happy helps with performance, with 17 out of the 24 agreeing, while the other 7 strongly agreed. This data proves that happiness does have an impact on performance in teenagers in the Greater Baltimore Metropolitan Area, showing a huge correlation between worker happiness and performance.

**Measuring the Impact of Light Pollution on Astrophotograph Image Quality Using Signal-to-Noise Ratio Analysis**

Aiden Bonicker

This study quantitatively measures how light pollution reduces the contrast and overall quality of astrophotography images. As light pollution continues increasing globally, it has become one of the greatest limiting factors of data collection for both amateur and professional astronomers. While the effects are often described qualitatively, obtaining numerical data more clearly reveals the true extent of its impact. To further investigate this effect, images with identical equipment and camera settings were taken from high and low light pollution environments under similar atmospheric conditions. Using image processing software, the noise levels and pixel brightness values of selected areas were extracted and used to calculate the signal to noise ratio (SNR) of each image. The data showed a 3.2 times increase in signal to noise ratio when in the dark sky compared to the light-polluted sky. Additionally, the measured degradation was slightly higher than what was expected using available satellite light pollution estimates. These findings show that light pollution significantly degrades image quality and may be underestimated by current models, reinforcing the importance of dark sky preservation.

**The Evolution of Cosmetic Marketing Representation**
De'asia Bradley

This study examines how marketing strategies in the cosmetic industry have evolved in response to growing demands for inclusivity, particularly among African American teens. The purpose of this research is to understand whether cosmetic brands have adapted to changing societal values and how their choices impact representation and accessibility for consumers of color. This topic is significant because teens are major contributors to the beauty market, yet their perspectives are often overlooked. The study used qualitative methods by gathering participant responses about their personal experiences with cosmetic brands. These responses were analyzed to identify patterns in opinions on representation, pricing, and product effectiveness. The results show that many African American teens feel excluded due to limited shade ranges, lack of representation, and products that do not work well for darker skin tones. Some participants also believed that certain brands intentionally neglect minority consumers while maintaining higher prices. In conclusion, the findings suggest that the cosmetic industry has made limited progress in inclusivity. Brands must improve representation and product development to better meet the needs of diverse consumers.

**Adolescent Trauma Management**
Laiba Butt

This study explores how environmental factors, specifically household cultural values, family dynamics, and trauma growing up, influence how adolescents regulate emotions. While previous research mostly examines only one influence, such as parenting or culture alone, this study addresses how multiple factors come together to impact you, including cultural background, social environment, and exposure to stressors like trauma and poverty. Using a qualitative, literature-based approach, this research synthesizes existing studies from developmental, cross-cultural, and emotional psychology to identify patterns in how adolescents manage emotions like anger, sadness, and anxiety. The results suggest that cultural values, such as individualism versus collectivism, significantly shape emotional expression and coping strategies, with stricter or more controlled environments often leading to more independent emotional regulation. Additionally, external influences such as migration, discrimination, and socioeconomic status further impact emotional development, demonstrating that adolescents within the same culture may regulate emotions differently due to personal experiences. This study highlights the importance of considering overlapping environmental influences when analyzing emotional regulation and provides insight for educators, families, and mental health professionals seeking to better support adolescent well-being.

**The Impact of the Highway to Nowhere on Black Communities in Baltimore**
Phineas Caiola

Systemic discrimination based on race in housing has been prominent in urban planning since America's industrialization in the 19th century. Following the Civil Rights Act of 1964, legislators, realtors, and urban planners were faced with the challenge of masking discrimination using more discrete measures. In the following years, redlining (the practice of denying housing to citizens primarily based on race), withholding healthcare, and building highways through primarily Black neighborhoods were used as a means of eviction. One of these highways, US-40, built to connect I-70 to downtown Baltimore and I-95, destroyed and evicted over 900 predominantly Black households. This highway's construction was eventually halted due to a lack of funding and became known as the Highway to Nowhere. Within existing literature, there has been extensive research conducted on discriminatory highway routing in cities such as Compton, Nashville, and St. Louis. This research primarily consists of the direct impacts of highways on housing and noise pollution. However, there is a gap in research regarding the impact on the sense of community itself in these locations. I plan on using a historical case study to explore the effects of the Highway to Nowhere's construction on surrounding Black communities in Baltimore. I will do this through analyzing contextual articles from other cities, along with primary and secondary sources regarding the highway's construction.

**How do Family Responsibilities Influence Burnout Levels Among Engineers, and What Coping Strategies Help Mitigate This Effect?**
Genesis Canton Majano

This study explores the prevalence and development of burnout among engineering students and professionals, as well as the strategies they use to cope with it. The rationale for this research stems from a noticeable gap in existing papers, where limited data addresses how burnout begins and evolves over time in the engineering field. Additionally, the study considers how both academic pressures and personal responsibilities contribute to burnout, making it a critical issue to better understand. A case study methodology was used, incorporating surveys with a range of participants at different stages of their engineering careers. The surveys included personal and reflective questions designed to capture experiences with stress, workload, and coping mechanisms. Participants included undergraduate engineering students and working professionals, allowing for a broader perspective on how burnout develops. The results indicate that burnout often begins during undergraduate studies, driven by intense academic demands and pressure to succeed. As individuals transition into professional roles, burnout not only continues but may intensify due to added workplace expectations and home responsibilities. Many participants reported experiencing burnout in multiple areas of life, however, they also identified various coping strategies, such as time management, seeking social support, and engaging in personal hobbies. In conclusion, burnout in engineering is a long-term and multifaceted issue that begins early and extends into professional life. Understanding these patterns highlights the need for better support systems in both academic and workplace environments to help individuals manage and reduce burnout effectively.

**Artificial Intelligence's Impact on Cognitive Development in High School Students**

Janiyah Chambers

This study investigates the influence of artificial intelligence (AI) on high school students and how it can impact their cognitive abilities and performances. In 2020, there was a significant increase in the usage of AI in education. Eventually, this has caused students to become overly dependent on technology. With this in mind and students consistently using outside resources such as ChatGPT and more, they could potentially hinder their own critical thinking, memory retention, and cognitive atrophy. This is a mixed methods study, which combines qualitative and quantitative data. This methodology allows the results study to measure how AI usage relates to cognitive performance while also understanding participants' personal experiences and attitudes towards the technology. The results of this study reveal that students that were in middle school during COVID-19 have a higher tendency to lean towards using artificial intelligence tools to assist them with academic assignments. In addition, their motivation and emotions play a role in determining their use of the resources, such as having a heavy workload and feeling overwhelmed or stressed. With high schoolers having consistent deadlines and major grade assignments, the data shows that students are more likely to use these sources to simply get the work done—as a shortcut—seeing it as more efficient and beneficial, relieving them of their stress and academic pressure. Overall, this data shows that with consistent use of AI-generated resources, students can feel as if they would struggle or lack the ability to complete the work on their own if they did not have the technology to assist them.

**The Impact Internet Culture Has On Identity**

Desire Coates

This research study examines how participation in internet culture influences adolescent identity through self-presentation and representation that is driven by a personal reasoning to understand the mix of connection and comparison that defines the life of teens today. Using a mixed-methods approach of phenomenology to capture personal experiences and content analysis to identify digital trends, the study surveyed 44 high school students, primarily seniors. The results reveal a significant identity split as 69.7% of participants admitted their online persona differs from their real-life behavior. Meanwhile, 60.5% feel more comfortable expressing certain parts of themselves online. This digital freedom is contrasted by intense pressure with 47.6% of the participants feeling a constant need to appear "perfect," and 51.2% report that social media makes them feel worse about their appearance or life. Altogether, 69.6% of students noted that likes and followers directly impact their self-esteem. These findings lead to the conclusion that internet culture has strongly transformed identity into something that is considered to be more performative where self-worth is increasingly tied to quantifiable and idealized standards. Ultimately, while online spaces offer a space for self-discovery, they often require a high emotional cost of constant comparison and image management.


**The Impact of Academic Pressure on Anxiety and Depression Among Adolescents**

Marisa Coleman

This study explores how academic pressure in competitive high school environments affects students' anxiety and depression, a topic that feels especially relevant as many students today constantly deal with stress tied to grades and expectations. The purpose of the study was to better understand not just how pressure impacts mental health, but also why some students seem more affected than others. To do this, I surveyed 26 students using the DASS-21 scale (0–3), focusing on academic stress, anxiety, and depressive feelings, and analyzed how often students reported moderate to high levels of these experiences. The results showed that many students feel overwhelmed, with 92% saying they are stressed about grades and 84% feeling constant pressure to perform, while others reported anxiety before tests, comparing themselves to peers, and feeling emotionally drained. Some students even shared that they've started to lose motivation or feel discouraged about their future. From these findings, I concluded that academic pressure has a strong impact on students' mental health, but factors like expectations from others, lack of rest, and self-confidence can shape how intense that impact feels, showing that schools need to focus more on supporting students, not just pushing them to succeed.


**Examining Health Inequities in Menopause Among Minority Women**

McKinley Curry

This study examines how menopause is experienced differently among women of color compared to the general population, focusing on the interaction between biological, social, and structural factors. The purpose of this research is to address gaps in existing literature, which often treats menopause as a universal biological process and underrepresents the experiences of racially and ethnically minoritized women. This study uses a qualitative literature review methodology, analyzing peer-reviewed research on menopause symptoms, mental health outcomes, and healthcare access across diverse populations. Sources were evaluated to identify patterns in symptom variation, treatment disparities, and the influence of social determinants such as socioeconomic status, chronic stress, and systemic inequities. Findings show that women of color are more likely to experience earlier menopause onset, more frequent and severe vasomotor symptoms, and a greater burden of mental health challenges. The research also reveals disparities in symptom documentation and access to treatment, as well as a lack of focus on mental health conditions beyond depression. These results suggest that menopause cannot be understood through biology alone and must be examined through an intersectional lens. This study concludes that more inclusive research is necessary to improve healthcare equity, increase awareness of diverse menopause experiences, and support more effective and culturally responsive treatment approaches.

**The Effects Of Money and Financial Literacy Within Familial Spaces**
Anthony Curtis

This is a qualitative research study that focuses on the emotions and overall wellbeing of citizens that reside within Baltimore and money within a capitalistic economy. I truly want to know how much money means to them, as each paycheck could ultimately be the deciding factor for whether someone has the opportunity to eat. When attempting to conduct interviews within this study, onlookers felt as though my study is slightly invasive or asks too much from a participant. I was able to interview only one participant so far and their input was the only other perspective that I've gathered, but it begs the question: is the world of financial literacy mainly composed of secrecy and privacy?

**How Discrimination, Stereotypes, and Racism Affects African Americans' Well-Being**
Mekhia Darden

The purpose of this study is to see how African Americans live their life when dealing with discrimination, stereotypes, and racism. The study was conducted by a descriptive case study, which is a research method that provides a detailed, in-depth account of a specific real-world phenomenon, event, or situation, focusing on documenting facts, characteristics, and dynamics without extensive interpretation or causal explanation. The data collected for this research looked deeper into each of the factors (discrimination, stereotypes, and racism) and their impacts for African Americans. The results were that African American youth are affected by racism and discrimination and that racial discrimination specifically has a toll on the youth mentally and physically. It was also found that when it comes down to healthcare, some African Americans are treated differently because some stereotypes are applied to African Americans when getting healthcare. This research shows that these factors have a great impact on African Americans' living and well-being.

**How Practitioners Handle Ethical Boundaries and Client Psychology in the Permanent Makeup Industry**

Kennedy Davis

Permanent makeup (PMU), also referred to as cosmetic tattooing or micro pigmentation, has grown significantly in popularity alongside the broader tattoo industry, with increasing demand for long-lasting cosmetic procedures. While existing research and training programs emphasize technical skill, sanitation, and regulatory compliance, less attention has been given to the interpersonal aspects of practice, particularly ethical decision-making and client psychological needs. As practitioners work closely with clients in emotionally sensitive and appearance-altering procedures, these factors play a critical role in professional practice. Within existing literature and training materials, there is a strong focus on how PMU professionals manage these challenges in daily practice. There is strong focus on safety protocols and procedural techniques, however, there is a gap in standardized guidance regarding how practitioners should navigate ethical dilemmas and assess client readiness. To address this gap, this study examines how PMU professionals manage these challenges in daily practice. Using semi-structured interviews, survey data, and content analysis of training programs, this research identifies patterns in practitioner preparedness and decision-making. Findings indicate that limited formal training in client psychology contributes to discomfort in declining clients and managing expectations, while greater experience and training improve confidence. Overall, this study highlights the need for more consistent and applied ethical and psychological training within PMU education.

**The Relationship Between Physical Activity and Academic Performance in Adolescents**

Camari Drake

This study looked at the relationship between how often high school students exercise and how well they perform academically. The purpose was to see if exercising more frequently actually connects to better academic performance, since there's a lot of discussion about how physical activity can impact not just physical health but also focus and thinking skills. Understanding this could help schools and students make better decisions about balancing academics and physical activity. To investigate this, I used a correlational case study method. I collected data from high school students using surveys that asked about how often they exercised each week, along with their recent test scores and GPA. After collecting the data, I analyzed it to see if there was any clear relationship between exercise frequency and academic performance. The results showed that there was no significant correlation between how often students exercised and their test scores. In other words, exercising more often did not necessarily mean students performed better academically in this sample. Overall, this suggests that exercise frequency alone is not a strong predictor of academic success. While exercise is still important, future research could look at other factors like intensity, sleep, or stress to better understand what actually affects student performance in a significant manner.

**Media Internalization and Identity Formation**
Makayla Edwards

This study investigates how exposure to different forms of objectifying media may influence self-reflection and self-identity, including thoughts about appearance, self-worth, and personal identity. Digital media is a powerful influence on self-perception because it exposes users to repeated images with thin-idealized, sexualized, and digitally altered body proportions. These videos encourage teens to compare themselves to unrealistic standards, affecting self-evaluation and self-esteem, and exposure to appearance-focused content can lead to self-objectification and shifts in self-identity. This study used a survey-based, correlational design to examine relationships between media exposure and self-perception among young women. Participants first reported their media consumption habits, including frequency of social media use, types of content viewed, and how often they encountered objectifying media themes. They also described any instance where they noticed changes in their self-perception. Participants then completed a Likert scale, one (strongly disagree) to five (strongly agree), assessing their immediate self-reflection after viewing media content, which included level of self-esteem, self-confidence, and identity-related thoughts. Results indicated that every participant in this study reported consuming media on a daily basis by both social media and streaming platforms. All participants reported noticing content displaying thin-idealization, sexualization, and altered body proportions depicted in media, with 50% of participants reporting experiencing a change in self-perception after noticing this type of content on their media platforms. Overall, findings suggest that exposure to objectifying content increases self-reflection and self-objectification but suggest no change in self-esteem or self-identity.

**Methodology in Exoplanet Discovery from 1998 to 2025**
Gideon Emhoff

The field of exoplanet research is one of the most accessible and understandable astronomical disciplines. Much of the previous research done in this field is open-access, and one does not need access to complicated equipment in order to study it. In particular, I was interested in the various methods of identifying and analyzing exoplanets. As I started my research, I realized that the transiting method was by far the most prevalent discovery method, and I wanted to know why. In order to do this, I performed a stratified random sample on all of the confirmed exoplanets to date in order to get a more comprehensive sample. I ended up with 60 planets reported in 40 different articles, and I analyzed the methodology of these articles. I found out that transiting was utilized by the largest exoplanet discovery surveys, where potential exoplanets were flagged for later review, and that the exoplanets flagged were always confirmed by another discovery method. Even though transiting seemed to be the most popular, there was always another discovery method used in conjunction with transiting. In the articles I read, multiple surveys were often used together, and observatories worked closely together in order to confirm the planets discovered. As exoplanet research is still a growing and developing field, it is hard for me to make a conclusion as an outsider, but I am very interested in exploring the new avenues of research emergent technology offers.

**The Effect of U.S. Government-Funded Research on the U.S. Economy from 1990-2024**

Fernando Gonzalez

This study examines how changes in the value of the dollar influence government research spending and the broader economy. The purpose of this study is to analyze how fluctuations in the dollar's value affect funding decisions, resource allocation, and economic priorities. This paper uses trend analysis methodology to examine the patterns and changes over time of the US dollar. The study mostly relies on publicly available data from government websites, economic reports, and budget records to analyze how changes in the value of the dollar relate to government research spending. The findings suggest that the change of dollar value has an effect on how the government decides to spend research money. The first thing to note is that the government kept the same percentage between GDP and R&D spending for two to five years and then increased the percentage. The second is that the increase in R&D is close to the inflation rate. This paper also highlights the increase in dependence on R&D spending by the economy. This suggests that there is connection between dollar value and spending, however, this paper does not deeply explore how others factors could affect this relationship.

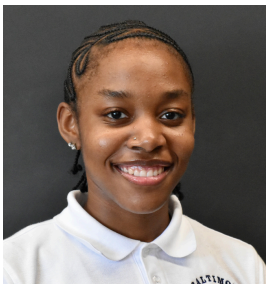
**Examining the Influence of STEM Representation in Films to Future Career Aspirations**

Heroine Guedjou

This study investigates the influence of STEM representation in films to future career aspirations, particularly among young Black girls. The purpose of this study is to measure the importance of representation in films and media coverage and to better understand how movies can influence young audiences. For my methodology, I conducted a survey that measured both quantitative and qualitative data. My survey focused on three main areas, including film exposure, representation and identification, and career aspirations. For film exposure, although 100% of participants knew of multiple STEM characters, many reported that they rarely see women of color being positively portrayed in movies. For representation and identification, the majority of participants expressed that representation does matter to them for various reasons like reliability and motivation. Finally, for future career aspirations, responses varied with some participants who were already interested in STEM before watching STEM-related films, while others weren't. When it comes to career aspirations, there are many outside factors to take into consideration, like personal interests, social influence, values, media, and more. My findings specifically suggest that, while media is not the only factor influencing career aspirations, it plays a significant role in shaping interest and self-perception. Representation in STEM films can encourage young Black girls to envision themselves in these fields, but the lack of consistent and positive representation limits this. These results highlight the need for more diverse and accurate portrayals of women of color in STEM within media to support and inspire future generations.

**The Heritability of Racism in Black Households**
Aria Harrell

This study investigates how the internalization of racism stunts cultural and communal growth for Black/African Americans in society. Talking about racism, it's always the aspect of white-on-black racism, which is extremely prevalent. This, however, gets repetitive when trying to find deeper responses to racism. The biological ramifications of slavery and its manifestation within the household is underrepresented, and it's strongly due to being silenced, misunderstood or even normalized. To conduct this research, I used phenomenology and grounded theory to build my own data from scratch based on the subjective responses in my survey and in-person interviews, which included questions about the dynamics and traditions of Black households. I found that the majority of my participants were Black women with similar answers to some of my inquiries. Through this, I analyzed prevalent patterns in the culture and pinpointed where growth would best fit internally. The results showed that many of the internal/household problems come from older generations teaching bad habits for survival in society as marginalized people. Many problems that were brought up favored old slave master tactics, and this perpetuates intergenerational adversity. Moreover, the patterns are categorical with the majority of answers split between moral and survival, suggesting that the culture's general worldview is based on self-conduction to appear in society and do it safely, since there's already predation to deal with. In conclusion, the household pressures in Black/African American homes can be problematic for growth and development.



**Traumatic Stress and Its Impact on One's Art Style**
Ma'Kele Hill

This study discusses how a person's art style can be affected by trauma they experienced when they were young. Research shows that children who go through trauma between ages 3 and 5 are more likely to become artists, writers, or dancers. They often use creative activities as a way to cope with their feelings. This happens because some people find it hard to express their emotions with words, so they use art to show how they feel inside. I chose this topic to help people better understand how to look at and interpret someone's art. One gap I found in my research is that small details in art, writing, or dance can help others feel and understand the message more deeply. If someone only looks at the surface, they might miss the real meaning behind the work. For my study, I used a Q&A method. This allowed participants to answer questions in a way that felt comfortable to them. They could skip questions, give short answers, or write as much as they wanted. They also had the option to share their own art, writing, or other creative work. Overall, my findings show that trauma can have a big influence on art. If people don't understand this, they might miss the deeper meaning and only see the surface of what the artist is trying to express.

**The Impact of Generational Trauma**
Nazmin Hosein

This research study focuses on the essence of Generation Z being consciously aware of generational trauma and how that awareness reshapes ideas about family and parenting because Gen Z tends to be more adaptive to bettering themselves compared to past generations. Phenomenology research is the method used for this study because the focus is on one's own lived experience. I had personal interviews with students ranging from the ages of 14 to 18. During the interviews, participants talked freely about their experiences that shaped their lives with guided questions like, “Can you describe what it has been like to grow up in your family? What specific experiences do you believe shaped your family dynamics? Why do you see your family like this? How has this influenced the way you think about relationships or family roles? How do you imagine yourself as a parent in the future? If you had to describe your overall experience being a Gen Z individual that's aware of generational trauma, how would you describe it?” As a result, it was found that family households with divorced parents often are mentally toxic and draining, students have high expectations of themselves, and parents don’t give students mental breaks from academics, and when thinking about parenting, students want to give their children the most support they possibly can. Moreover, Gen Z is able to easily recognize trauma passed along in their family and is choosing to stop that tradition by giving their own future children the support and reassurance they wanted from their parents.

**The Role of Filamin B in Pancreatic Ductal Adenocarcinoma**
Steysi Imbert-Sandoval

Pancreatic Ductal Adenocarcinoma (PDAC) is one of the most lethal and aggressive types of cancers as the cancer has already metastasized at diagnosis for 51% of all patients. Cancers are characterized by having a dysregulated cytoskeleton, a network of proteins that provide support to the cells, which influences their metastatic ability. In our lab, we found that PDAC has some cytoskeletal proteins that are upregulated with disease, and these proteins are mechanoresponsive, allowing them to survive mechanical stresses. Filamin B (FLNB) is one of these proteins and serves as an actin crosslinker, providing structural support to the cells. These observations have led us to question why FLNB is upregulated and mechanoresponsive in PDAC. Thus, we are interested in how loss of this protein affects cellular behavior (e.g., cellular growth and adhesion). For this, we are going to assess cellular growth over time, measure cell adhesion, as well as, utilize biochemistry and microscopy techniques. Overall, this work will contribute to the understanding of the role of FLNB in pancreatic cancer as well as its potential to be targeted to inhibit cancer progression.

**How They See Us**
Navaeh King

The mistreatment of anyone is a threat to the treatment of everyone. For centuries, Black individuals have been captured, enslaved, discriminated against, and dehumanized, even after the passing of federal laws, amendments, and the progression of society. Black individuals still don't have the same opportunities as their white counterparts and are constantly put into the narrative of violence and failure. Through a Google Form questionnaire, I showed 3 movie clips to 3 different high school classes, ranging from grades 10 to 12, and instructed the respondents to answer a series of questions after each clip was shown. The questionnaire was anonymous and the respondents had the opportunity to not consent to the questionnaire. I found that there was no correlation between the negative stereotypes of Black individuals in the media and the opinions outside demographics had on the Black community. While many of the Black respondents proved the notion found in my literary sources that negative stereotypes in media have a negative impact on the body image and self esteem of Black individuals, I did not find a positive correlation between the non-Black responses and the negative stereotypes displayed in the movie clips shown. Results suggest that the negative depictions of Black individuals in the media and film do not directly correlate to the opinions non-Black individuals have about the Black community, and those opinions are not shifted through the displaying of negative depiction of Black individuals in the media.

**The Negative Influence of Technology on the Youth from a Psychological Standpoint**
Carley Layton

This study focuses on the effects of social media on the mental health of children and teenagers. Social media has already been known to be bad for our mental health because of the harmful messages that are constantly shared across platforms. While social media does provide benefits, the cons still outweigh the pros. With technology being the backbone of our society, it's honestly unavoidable given that it’s practically everywhere. These findings, however, were things that were recorded by adults. A major gap in research that was identified was that there were little to no firsthand accounts from children, who are directly affected by social media the most. Using a case study, I interviewed a small group of 10 children and inquired about how much access to social media they have and how it makes them feel. Out of the group, it was mainly the older children who said that they felt the most negatively impacted by social media because of the things that they’re already exposed to. When I’d asked how it made them feel, they said that they had trouble communicating with others, self-image issues, and identity issues. My overall findings suggest that children who have more unrestricted access to social media tend to have more mental health issues, and they don’t have a proper place to receive help because social media is practically everywhere.

**Parental Perceptions of Screen Time and Its Impact on Early Childhood Language Development**

Laylaa Long

This study investigates how parents of young children perceive the impact of screen time, including both educational and entertainment content, on early language development. The purpose of this research is to better understand parental beliefs, experiences, and the relationship between screen use and language outcomes, as parents play a critical role in shaping children's media use and language environments. A phenomenographic approach was used, combining survey data with findings from ten peer reviewed studies to compare lived experiences with existing research while exploring the different ways parents experience and interpret screen time. Data was collected through surveys of nine parents, focusing on screen use, content type, parent involvement, and perceived effects on language development. Survey results indicate that most children (66.7%) use screens for less than one hour daily, with a mix of educational content, such as Khan Academy and PBS Kids, alongside entertainment platforms such as YouTube and Netflix. The majority of parents (88.9%) reported no noticeable differences in their child's language development, while a small percentage observed either positive or negative effects. In contrast, peer-reviewed research shows that higher screen time, particularly passive use, is associated with poorer language outcomes, including reduced vocabulary development and fewer parent-child interactions. Studies also emphasize that educational and interactive screen use, especially when paired with parental involvement, can support language development. Overall, findings suggest a discrepancy between parental perceptions and research evidence. While parents often view screen time as neutral, existing research highlights potential risks when screen use replaces interactive language-rich experiences.

**The Development of Afro-Pessimism and the Impact on Black Expressionism in Modern Society**

Mikayla Maclin-Ray

This study investigates the development of Afro-Pessimism throughout enslavement and how it began to evolve and affect black expressionism methodologies in modern society. The purpose of the research is to further understand the connection between the long-lasting effects of enslavement that impacted the ways in which Black people express themselves within or to society, whether that is culturally, politically, artistically, or economically. For this study, a brief but descriptive survey was used. I surveyed a total of 13 participants, ages 75 and under (it was specified it was more relatable for a certain racial group), who were given 13 questions each. Questions in this survey asked participants whether they've experienced wrongful misjudgment, their comfortability with self-expression, and to reflect on moments where they haven't felt the most comfortable under certain conceptions. This involved questions where the choices were commonly agree, disagree, neutral, etc., for participants. Survey results revealed that the majority of respondents for questions that mostly focused on the social and emotional impact of expression had a wide mix of different perspectives and opinions. Questions that seemed to be more focused on the artistic and historical aspects and impacts on Black expressionism held more simplistic responses. Overall, findings suggest a gap between the alternative perspectives on the emotional impacts on Black expressionism and the historical and artistic aspect of it. While individuals in society seem to have more perspectives on the mental/societal impact of enslavement on expressionism, the connection between the knowledge of history within the community and disparities within it need to be more heavily studied.

**Cultural Identity and ESOL Programmatic Efficacy**
Genesis Martinez

This study investigates Armistead Gardens School to answer the effectiveness of the teaching of its Hispanic ESOL students while preserving their cultural identity. The growing attention on immigration and funding for educational programs opens conversation on ESOL, as a majority of ESOL students come from immigrant households. Looking into the impact of ESOL finds what aspects need to be changed and allows its importance on communities to be addressed. 8 teachers were interviewed and 14 students were either interviewed or surveyed. Teachers at AG work within a limited time frame, so they develop their own methods to effectively teach. Many instructors encourage students to share aspects of their cultures with one another. They are also conscious when it comes to Spanish usage during instruction time. They avoid putting Spanish in a negative mindset and instead choose to ask their students to repeat what they said in English. A majority of staff and students felt that their cultural identity was being celebrated frequently throughout the school year. Although many students have responded positively to being pulled out for ESOL, a few students did report not needing the program at all. The majority of students and staff report good feedback on their experiences with ESOL and its effects on the education and cultural identities of students. It is important to note how diverse Armistead Gardens is and question how it would compare to a school with less cultural and linguistic diversity.

**Pet Health and Its Effect on the Mental Wellbeing of Teens**
Victoria Moffatt

This study examined how the physical health of pets influenced the mental wellbeing of high school teens. Previous studies have shown the emotional benefits of pet ownership with a few actually specifically focusing on how the illness of the pet can affect the mental wellbeing of teens that rely on them for emotional support. The purpose of this research was to better understand how teen pet health challenges can cause increased stress, changes in daily functioning, and emotional strains. Phenomenology was the methodology approach that was used. This was used to better understand the lived experiences of these teens and how their pets' physical health affects/affected their mental health. A mixed-question survey was carried out with 19 high school students from grade 9 through 12. Questions were about pet ownership, stress levels, caregiving responsibilities, coping strategies, and emotional attachment. This included 17 multiple choice and 5 open ended questions. Several responses were rated on a scale from 1-4 and provided the opportunity for detailed descriptions of their experiences. This approach allowed the study to be able to capture patterns and explore personal experiences. Results show that most participants owned a cat or dog and established a strong emotional attachment to these pets. While the majority of teens described their pets as a source of stress relief and comfort, some responses revealed increased worry, emotional strain, and academic disruption when pets become ill. Less than half reported missing schoolwork or activities to care for their sick pets, and most participants had not thought of seeking or sought support from counselors or adults. Overall, these findings showed that healthy pets contribute to emotional stability, while ill pets can have a negative impact on teens' mental wellbeing. This could help parents, counselors, and educators better understand and support teens.

**The Importance of College Readiness**
Maziyah Nolan

The research study focuses on the importance of college readiness as a critical determinant of academic success and long-term socioeconomic mobility for students transitioning from secondary education. The purpose of this study is to uncover the gaps of achievement in higher education, where many students struggle due to inadequate preparation and little to no critical thinking, social awareness, or financial literacy skills. This research uses a mixed-methods methodology and evaluative case study. This combination integrates quantitative data and qualitative data and allows me to compare and contrast my data to published media for complexity. I created a survey that questions the work-life balance and level of readiness of Poly seniors to get their personal perspectives of if high school has done a noteworthy job at preparing them for life after graduation. While college is not the next move for all graduates, I believe it is really important to examine the efforts of counselors and teachers. The results show that there is a strong positive correlation between the responses of Poly seniors. The data reveals that most seniors feel pretty prepared for their future endeavors and believe that Poly has supplied them with the skills to handle themselves in other academic environments. In conclusion, I found that college counseling for high school seniors indirectly prepares them for the non-academic transitions to college, and their academics will be reflective of their ability to maintain the work-life balance they obtained during high school.

**Treating High School Anxiety with the Ukulele**
Ben Paglinauan-Warner

This study examined how learning chord progressions on the ukulele that end in musical consonance can reduce feelings of anxiety and stress in high school students. The purpose of this study was to explore an alternative mental health treatment for teenagers that is more accessible than conventional treatments like antidepressants, which are commonly associated with high financial costs and negative public stigma, and to potentially advocate for increased music education for teenagers. The study utilized an evaluative research method, evaluating the overall effectiveness of sessions where high school students learned chord progressions on the ukulele in reducing feelings of anxiety. This included surveys and interviews to collect both numerical and qualitative data. Before and after the study, the participants completed the State-Trait Anxiety Inventory (STAI) to self-evaluate their feelings of anxiety, the results of which were then compared to analyze any changes. The participants also completed brief recorded interviews where they reflected on their experience of the whole process. In the lesson, the participant was instructed in playing one or two simple chord progressions on the ukulele, consisting of four chords each. The results from the STAI were significant, showing moderate to high decreases in feelings of anxiety for all participants. Participants who originally reported the highest feelings of anxiety experienced the largest percent decrease. In the interviews, multiple participants described feeling less stressed and satisfied after their lessons. Overall, the results support music education and the use of the ukulele in treating teenage anxiety, but more research is needed.

**Psychological Development of Adolescents' Interference Within Relationships and Daily Interactions**

Damia Person

This study observes psychological development and its impact/interference within relationships and daily interactions. Psychological development of adolescents is highly significant in how we make everyday decisions in the present. After receiving responses to my survey, reports revealed patterns within environmental influence, trauma, coping, and relationships. In order to have a successful methodology, I observed existing research from psychologists, along with data on adolescent mental health trends before and after the pandemic. Researchers also examined common factors influencing teens and reviewed possible interventions such as screenings for anxiety and depression. These results are important because they strongly represent patterns in factors that influence one's behaviors within relationships, social interactions, and self values and tolerance. These responses can be used in helping psychologists compare results and examine coping mechanisms that help adolescents develop without allowing past events to influence their adult and teenage behaviors. These results should be taken into consideration being that this is recurring within children/adolescents. I'd overall conclude that my information could increase the focus on what can be done to help heal adolescents from these past events so that they are no longer allowing past traumas to impact their present interactions with the people around them. Psychologists play an important role in preventing adolescents from allowing their past to control their future, although they cannot fully eliminate the challenges teens face, it's still important that they provide support. Mental health struggles are complex and influenced by multiple factors, meaning solutions require ongoing support, early intervention, and involvement from families and communities, not just professionals alone.

**Cultural Costumes: The Relationship Between Celebrities and Culture**

Nadia Robinson

As social media becomes increasingly influential in our lives, it's important to understand how this new outside force is impacting cultural relations. Groups of people will always interact no matter what, and finding the most ethical and respectful way to do so is necessary to reduce conflict, isolation, and discrimination between groups. This study uses phenomenography to allow for an in-depth qualitative study of student cultural perceptions as they relate to celebrity and influencer following. 11th and 12th graders were the target participants in attempt to obtain thorough and mature responses, something that may not have been achieved if younger students participated. After the demographic portion, participants were asked about their social media habits. The following questions referenced how one feels about certain celebrities/influencers in relation to culture. 12 responses were received. Many participants expressed connection to social figures that shared similar cultural/racial identities and even felt negatively represented by the same. Many participants see physical representations of themselves in media--people that share cultural backgrounds and/or the same skin tone as them--and it alters and/or augments their views of the community. These results connect the idea of cultural identity to social media habits, two variables that directly impact one another. This adds further understanding to how social figures and social media are affecting personal and non-digital lives, values, and perceptions. Understanding this modern relationship will help decide how best to engage with other cultures, mitigate damaging mission creeps, and limit harmful social influence.

**How Does Viewing Different Orientations in News Style Affect a Viewer's Understanding of Events?**

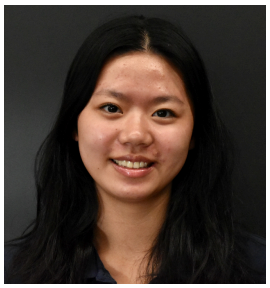
Will Rousos

This study examines how the consumption of various news sources can skew perception of events. Generally, this is applicable to how the media affects our understanding and views on global/national events. To do this, a survey was conducted in which a volunteer would watch three short news clips from varying sources. These sources would vary in ideology. First, they would watch a news clip from a right-leaning source, and then report their views on the parties involved in the clip using a 1-5 scale, with 1 being negative, 5 being positive, and 3 being neutral, along with the news source itself being reported on. This same process was repeated for centrist and left-leaning sources. In this study, the news clips provided were related to the topic of the US's invasion of Venezuela and the capture of its president. For the opinions on Venezuela, an overwhelming 72% of respondents responded with a 3, neutral, while 18% chose 2, and 9% chose 4. For opinions on the source, the findings are as follows: #1-24%, #2-33%, #3-25%, #4-16%, #5-0%. And lastly, opinions on the US, the findings are as follows: #1-7%, #2-69%, #3-7%, #4-7%, #5-7%. For centrist, 50% gave a 3 for Venezuela, 50% gave a 4 for the source, and 50% gave a 2 for the US. For left-leaning, 50% gave a 3 for Venezuela, 64% gave a 3 for the source, and 35% gave a 2 for the US and 28% gave a 3. From these findings, I can conclude that, within this population, it is identifiable that right-leaning news sources make people sympathize with Venezuela and unsympathetic with the US, additionally painting the news source in a bad light. From the centrist/generally unbiased source, the trend is similar to that of the US and Venezuela, but with a slightly better look at the US and the source. Lastly, the left-leaning news source shows generally neutral opinions on each subject except for the US, which is slightly negative.

**The Impact of Trump's Racist Rhetoric Towards Latinx Youth**

Ibeth Ruano Hurtarte

This inquiry investigates the impact of Donald Trump's racist rhetoric on Latinx youth and its relationship to mental health outcomes. The purpose of this research is to determine whether exposure to such rhetoric correlates with increased emotional distress and to address the gap between Trump's first and second presidential terms. Data was collected through a Google Form survey consisting of 24 questions, distributed to Latinx youth but not limited for individuals of other backgrounds. Questions gathered demographic information and responses about emotional, social, and political effects of exposure to racist rhetoric. The results indicate a strong perceived impact on mental health, with many participants reporting feelings of anxiety, fear, anger, sadness, and stress. A consistent trend across responses was that these effects are long-term, influencing not only emotional wellbeing but also trust in government and community dynamics. Additionally, while negative emotional impacts were widespread, some participants reported increased political awareness and engagement, such as attending protests or becoming more informed about social issues. These findings support the hypothesis that exposure to racist political rhetoric negatively affects Latinx youth's mental health. The study highlights the broader implications for youth development and community stability. Limitations present included reliance on self-reported data and a limited sample size. Future research could expand participant diversity and explore long-term psychological outcomes more deeply.



**The Effects of Lactylation-Mimetic K156Q Mutation on cGAS-STING Protein's Autoimmune Signaling Function**

Sabrina Shi

cGAS is a signaling protein that has the ability to bind the DNA of foreign organisms such as bacteria or cancer cells. When binding occurs, cGAS sends a message to the signaling pathway STING that activates other messengers to signal the immune system to expel the foreign invader. The body requires oxygen to regulate cellular respiration, however, when oxygen becomes limited, the body switches pathways in producing glucose and ATP, which releases the byproduct lactate molecules. This indirectly causes lactylation, the build-up of lactate molecules. When lactylation occurs, the body is strained and more prone to diseases. To investigate the occurrence of lactate build-up and its correlation to diseases, the binding and signaling ability of cGAS-STING to 24bp-dsDNA and 64bp-dsDNA is analyzed. cGAS protein is mutated with lactylation mimicking mutation K156Q and inserted into *E. coli* cells for expression. Wildtype protein and the K156Q mutated protein are placed in separate columns with 24bp-dsDNA and 64bp-dsDNA, and binding ability and activity is measured by the KD curve. Results show that Mouse cGAS wildtype had a KD of 35.9 ± 10.9 nM when binding to 60 base pair (bp) dsDNA and a KD of 501.1± 122 nM when binding to 24bp dsDNA. The mutant Mouse cGAS K156Q had a KD of 120.8 ± 38nM when binding to 60bp dsDNA. The wildtype cGAS-protein without the mutation has a lower KD, indicating strong binding affinity, conversely, the K156Q mutated protein has a higher KD, indicating weaker binding affinity, over 50% less than wildtype cGAS. When lactylation occurs, cGAS protein's ability to bind to DNA significantly weakens, preventing its ability to signal the immune system to fight off diseases, therefore, lactylation indirectly causes illnesses such as cancer.

**The Impact of Health-Related Lifestyle Factors on Rate of Improvement at Tasks**

Max Surkan

Have you ever wanted to become skilled at a game or sport? Have you ever wished you could get good at something more quickly? This study aims to help answer this question by increasing the knowledge base around the subject of skill acquisition. This study is researching how people's health-related habits/factors affect their rate of improvement at games. Hopefully, the answer to this question could help people trying to improve at a task to improve more effectively. This study compares the rate of improvement of chess players to several lifestyle factors, such as the amount of sleep, time spent socializing, physical activity, etc., that they get per day. Improvement was measured by chess skill (Elo rating system) over time played (# of games). In order to gather this information, a survey was distributed across online chess spaces asking their # of games, Elo, and questions about their lifestyle. What were the results? Based on preliminary reading, certain factors were hypothesized to have a positive effect. However, based on analysis of the 20 surveys received to date, the study was inconclusive.

**How Has the Improvement of Baseball Statistics and Data-Collection Methods Impacted the Game?**

Finnian Talbot

America's pastime has long been aptly called a "numbers game". Since Henry Chadwick invented the box score in 1858, the game has been evolving into a sport where statistics mean everything. Despite its nickname, the sport has barely any existing research directly assessing the impact of statistics on how it is managed, played, and watched. Given this, this study aims to fill that gap in research by offering direct views from people across baseball. As a result, this study reinforced the thought that baseball is heavily impacted by statistics, while also adding depth to how this impact is felt. Through the use of interviews, as well as the synthesis of multiple studies, this study fills the gap in research. There is proof of direct impact in the management of an MLB team, the viewing of baseball at an MLB level, and the play of baseball at a high school level. In addition, the synthesis of multiple other research papers shows a clear impact on umpiring and injury management. These findings add a necessary level of analysis to the existing information about baseball and statistics.


**Kk! Skincare**

Ja'Shawna Taylor

This study is based on the fact that people of darker skin tones are less likely to try Korean skincare due to language barrier. I conducted my research by watching videos: monitoring how many days the product(s) were used, if they worked or not, their problems, and why they finally chose to use skincare. What I found is that many people both white and Black have very severe acne to the point they've tried everything, and because of their skin sensitivity, it makes it even harder to take care of it. They do mention that they were advised to try Korean skincare, or they finally got desperate enough and listened to the ads and Tik Toks they were seeing. Basically, this means that I was right that people (mainly people with darker skin) rarely try to use Korean skincare. It's understandable that people don't use that type of skincare due to Korean wording or not being able to read the back of the bottle. Honestly, this means that people need to do their research on brands if they're not sure of the results or wording. Personally, I found out earlier that the foundation that I use is Korean. I had watched a Tik Tok video of a Black woman showing it off, but I had not remembered that she had said it was a Korean brand. I just knew it was gonna hold up for a while, and that's why I chose it. Understandably, not everyone thinks that way, so I think people should just do their research on skincare brands before they try them, or if they are scared to try them, instead of not giving them a shot at all.

**Inside the Mind Of A Criminal: The Developmental Relationship Between Psychopathy and Criminal Thinking Patterns**

Kaden Thomas

This study examines how the development of psychopathy influences criminal thinking patterns, with the goal of understanding why individuals with elevated psychopathic traits are more likely to engage in persistent offending and distorted moral reasoning. The rationale for this research is to clarify the relationship between personality traits and cognitive processes involved in criminal behavior. Empirical studies from peer-reviewed databases, including correlational and longitudinal research, meta-analyses, neuroimaging (fMRI) studies, and behavioral and cognitive assessments, were reviewed. These studies included incarcerated offenders, juvenile populations, clinical samples, and community groups in order to compare psychopathic traits across different environments and developmental stages. Results consistently show a strong positive correlation between psychopathy scores and criminal thinking patterns. Higher psychopathy levels are linked to increased recidivism, greater institutional misconduct, earlier onset of antisocial behavior, and more persistent criminal tendencies. Common cognitive patterns include justification of harmful actions, externalization of blame, emotional detachment, lack of remorse, and manipulative interpersonal strategies. Primary psychopathy is more associated with calculated, goal-directed offending, while secondary psychopathy is linked to impulsive and emotionally reactive crime. Overall, the findings suggest that psychopathy significantly shapes criminal cognition by influencing how individuals process emotions, interpret consequences, and rationalize behavior. This indicates that criminal thinking is not solely situational but is strongly influenced by stable personality traits interacting with environmental factors over time.

**Artificial Intelligence In Echocardiography Imaging For Pediatric Patients**

Jada Turner

This research examines how artificial intelligence (AI) is helping improve the accuracy and speed of echocardiograms for detecting congenital heart defects in kids. In this study, results show that AI can help doctors find defects earlier, reduce mistakes, and make the process faster. Based on the research, AI has shown strong potential in analyzing heart images more quickly and identifying abnormalities that might be missed by the human eye. This can lead to earlier diagnoses, which is very important for treating heart conditions in children. If earlier detections become available due to artificial intelligence (AI), we can know about heart conditions as early as fetal stages. Working with this tool on echo machines allows doctors to get measurement estimates before they go in and make their own. Early detection directly impacts treatment for children. When heart defects are found sooner, doctors can create treatment plans earlier, whether that includes medication, monitoring, or surgery. AI isn't meant to replace doctors, but it works as a strong support tool for many cardiologists and sonographers for time purposes. Overall, my research aims to show the importance of technology and how it's evolving in our healthcare system, specifically pediatric cardiology.

**The Psychological Power of Belief: Exploring the Placebo Effect in Sports**
Malaya Victor

This study explores the psychological power of the placebo effect in sports and how belief, expectation, and mindset may influence athletic performance even when no measurable physical change occurs. While existing research has examined placebo effects in controlled settings, less attention has been given to how athletes personally experience these effects in real sports environments. To investigate this, survey data was collected from student athletes regarding their experiences with treatments, routines, coach communication, and mental preparation. Results showed that most participants believed psychological factors such as confidence, trust, reassurance, and expectation positively affected their performance, motivation, and pain tolerance. Many athletes reported feeling more prepared or capable after receiving encouragement, treatment, or pre-performance routines, even when unsure of the physical effectiveness. However, participants also emphasized that mindset has limits and cannot overcome serious injury or major physical restriction. These findings suggest that while placebo-related psychological boosts can meaningfully improve athletic performance, they function best alongside genuine physical readiness. This research contributes athlete-centered perspectives to the study of placebo effects in sports and highlights the importance of mental preparation in athletic performance.

**Impact of Architecture on Sensory Comfort, Focus, and Wellbeing of Children**
Shanerah Wallace

This study talks about how specific environmental and architectural design elements impact individuals', including adolescents and adults with or without invisible disabilities, ability to focus, learn, and work effectively. Using multiple credible sources and data from a survey I conducted, I determined key factors such as noise level, lighting, layout, space and size play a major role in an individual's ability to be effective and efficient in daily activities that may seem easy to someone who doesn't have an invisible disability. Through my survey, I have also found that not all individuals with invisible disabilities are affected the same by certain elements. That's also true for individuals who don't have an invisible disability, however, I found that almost all of the participants with an invisible disability or not were impacted in some way by specific design elements. The study concludes that it is essential that spaces be built to accommodate individuals with physical disabilities and neurological disabilities too. By doing this, it will promote equitable education and heavily support and promote diverse learning.

**The Impact of Human Interactions on the Environment**
Christopher Williams

This paper investigates and studies how our everyday interactions affect our environments. The research is to help identify how our everyday habits affect the environment. It also analyzes if the effort or lack of effort affect the environment. Climate change, whether people believe in it, is a real thing that should and needs to be taken seriously. I wish to help narrow down how our everyday norms and lives play a role in the health and wellbeing of our environments. I used a quantitative/qualitative (mixed method) research method when I sent out my survey, meaning I used both detailed responses and a quick multiple choice answer survey. A QR code was given to randomly selected individuals ranging from 16 year old high school students to seniors citizens. I had a total of 40 participants. I made it clear in the survey that they did not have to answer every question in the survey if they did not want to. The results that came from the survey was as expected. The questions asked ranged from their political alignment to what they do to help lower greenhouse gas emissions. After all the researching, I expect this paper to be used to analyze what exactly we do as individuals that directly impacts the environment. The contents of this research can vary from social psychology to environmental science. Overall, this research shows correlation between individuals in Baltimore and their choices, which will impact the future of our planet's health.

**The Effects Of Mental Hospitals: Helpful or Harmful?**
Chinzere Wright

This research study is an examination of whether mental hospitals improve or worsen their patients' mental health. The purpose of this study is to find out the media accuracy of mental institutions and help people understand the actual experience people get when admitted into these places. My study's purpose is to look at both the benefits and the potential harm these places cause. My study uses a qualitative research approach. I analyzed documents, articles, case studies, and first hand patient accounts. Using this tool, it allowed me to identify patterns as well as differences in all of my articles varying in categories such as treatment types, patient experiences, and outcomes. My results ended up being that mental hospitals can indeed provide support, however, my findings also reveal that these institutions can have negative experiences, as well, a big one being patient loss of autonomy. What I came to conclude is that patient outcomes vary depending on factors like quality of treatment, the hospital, environment, and the patient themselves. To conclude, mental hospitals cannot just be "good" or "bad", rather their impact is completely defined by patient experience. My study highlights the need for improved environments and patient care in these places so everyone can get the help they need.

**The Experience of Being an LGBTQ+ Individual and Its Impact on Stress Levels**

Chelsea Zellous

This study investigated the discrimination towards LGBTQ+ individuals based on the way they identify and how that contributes to the stress that they experience. The purpose of this study is to gain a deeper understanding of the way negative opinions and actions can affect a person's state of mind, as well as how these inconsiderate statements cause an increase in stress levels. A phenomenological method was used in addition to a qualitative study to gain insight on lived experiences that not only people have been through but also have witnessed. Data collected from 17 participants focused on the discrimination that people have dealt with in addition to how they felt in the moment. Study results indicate that a decent amount of LGBTQ+ individuals (41.2%) have faced discrimination because of the way they identify and the way they choose to express their identity. Furthermore, these individuals also felt that the negative comments that they've received have caused them to feel more stressed in addition to having a changed mindset in the way they view themselves. Study results also indicate that individuals who don't identify as LGBTQ+ (58.8%) have witnessed and/or made continuous offensive comments towards LGBTQ+ individuals. All in all, findings suggest that discrimination towards a person's identity causes an increase in stress levels, and while not always intentional, inconsiderate comments add on to the stress load.



# CAPSTONE INTRO TO RESEARCH AND AP SEMINAR

**About Advanced Placement (AP) Capstone Research:**

In its ninth year at Poly, the AP Capstone Research Program is serving 120 students in grades 10 through 12. The program's focus is on facilitating process-driven academic research outside of the laboratory. Students begin in 10th grade (Introduction to Research Methods) with a combination of textual analysis, analysis, and synthesis skills. In 11th grade (AP Seminar), students complete 3 papers to support an academic argument. Lastly, in 12th grade (AP Research), students conduct original research studies on topics of their own choosing. The goal is to increase student access to an academic research program and expand access to advanced academic opportunities for the betterment of the entire school community.

# EXTERNAL STUDENT RESEARCH

These students participated in research outside of Ingenuity's Research Practicum and the AP Capstone program.

**Johns Hopkins Summer Academic Research Experience (SARE)**
**Generate a CRISPR-Cas9–Mediated NLRX1 Knockout in Human iPSCs to Investigate its Role in Oligodendrocyte Maturation and Function**
Junior Mondragon Soto
**Mentor:** Dr. Mansoureh Barzegar
Department of Ophthalmology, Wilmer Eye Institute, Johns Hopkins University

This project aimed to generate a NLRX1 knockout human induced pluripotent stem cell (iPSC) line to enable further studies of its role in oligodendrocyte (OL) development. OLs are capable of producing myelin that serves as a protective coat for our neural axons in the central nervous system. Their dysfunction however stems from demyelinating diseases like Multiple Sclerosis. NLRX1 is a mitochondria-associated protein known to regulate neuroinflammation and general mitochondrial function, suggesting that it may influence OL development. The iPSC line was routinely maintained and tested for mycoplasma to ensure cell quality, enabling further experiments. To create the knockout cell line, the CRISPR/Cas9 gene editing strategy was used to introduce a loss of function mutation within NLRX1. The CRISPR plasmid was delivered using Lipofectamine. Additionally, the CRISPR plasmid included a puromycin resistance gene to select successfully edited cells. Gel electrophoresis using a PsyI restriction enzyme indicated success in generating cell lines that largely lack NLRX1 function. Future work will include further validation of the knockout, such as further puromycin selection, western blot analysis, and sequencing. Additionally, in the long-term, differentiation of these iPSCs into OLs will be done to study their development and myelination properties. Ultimately, this project establishes a foundation for future researchers to investigate OL development and may contribute to identifying therapeutic targets to promote remyelination against demyelinating diseases.

**University of Maryland Research and Mentoring Program (RAMP)**
**Impact of Endurance Exercise on Progesterone Levels in Eumenorrheic Women**
Crystal Thapa
**Mentor:** Anna Pudder
School of Medicine, University of Maryland

Progesterone is a endogenous sex steroid hormone that plays a crucial role in regulating the menstrual cycle as well as supporting reproductive function. Progesterone is far more abundant in women and primarily produced in the ovaries created by the corpus luteum, a temporary endocrine structure that forms after ovulation. In eumenorrheic woman, progesterone levels fluctuate predictably due to regular menstrual cycles. As fluctuations can be caused by stress and energy level, endurance exercise may impact these levels. Exercise works as a stressor, which leads to the body responding in a complex process involving hormone release. Exercise also causes cells to have increased hormone sensitivity, making the body more sensitive to changes caused by hormones. While there are many studies describing how other sex steroid hormones are affected during different activities, there are little experimental studies done involving progesterone. Therefore, our focus is on how endurance exercise impacts progesterone levels in eumenorrheic women.

# Class of 2026

James Addo | Layomi Adedeji | Nabil Aime | Laila Allsberry | Josh Amper | Braylon Anderson

Armin Ataei Kachoei | Arman Ataei Kachoei | Morris Auerbach | Faiber Balanta-Cabezas | Tara Bass | Chonan Bell

Donnovan Bey | Mykhi Brooks | Ka'Ren Brown | Jerome Brown | Kaii Bushyager | Phineas Caiola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Noah Mayfuila

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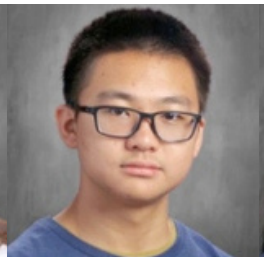
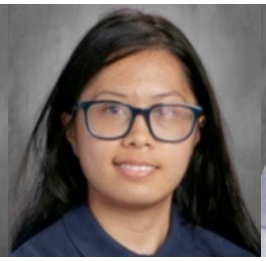


Frank Mei



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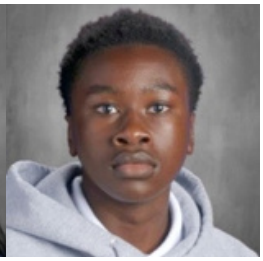

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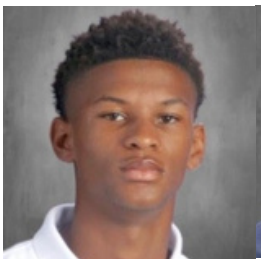

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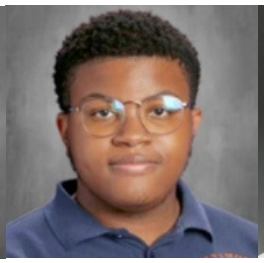

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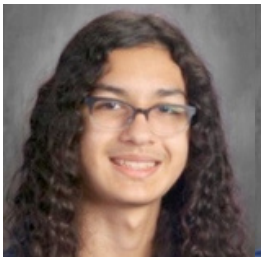

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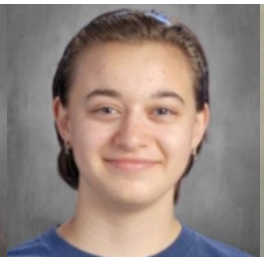

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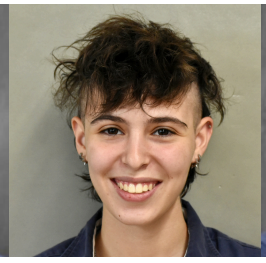

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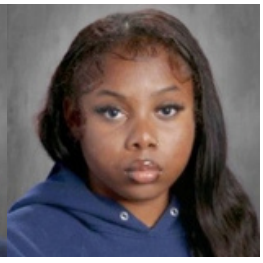

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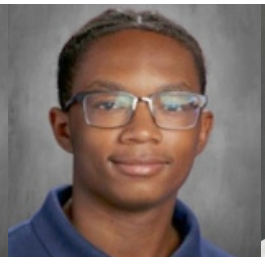
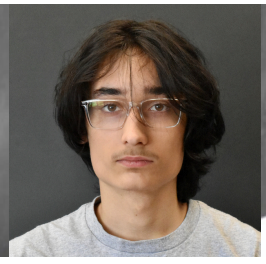


Carter Sparks



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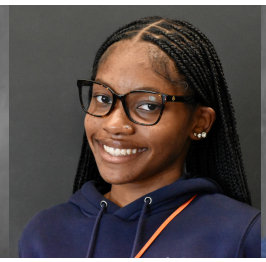
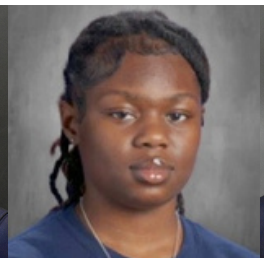
William Underwood



Malaya Victor



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Chelsea Zellous

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Calling all families, organizations, nonprofits, and businesses!

## JOIN US IN EMPOWERING TOMORROW'S STEM LEADERS!

Ingenuity is redesigning its 2026 summer programming for grades 8-12 to ignite curiosity and leadership through immersive STEM experiences and advanced enrichment to prepare the next generation of STEM leaders. This includes a new 4-day rising 8th grade academy, 3-day entering 9th academy, 2-day rising 10th grade academy, a 3-day rising Junior STEM Leadership Summit, and college essay writing workshops for rising seniors.

THE INGENUITY PROJECT
SUMMER PROGRAMS

For four years, federal recovery funds acted as a bridge. Now, it's time for our community to take the lead in sustaining this momentum so that Ingenuity can provide expanded and transformational summer programs at no cost to nearly 300 students in 2026.

**Your support is vital!**

## BENEFITS OF SPONSORSHIP

A unique opportunity for you, your family, or employer to partner with The Ingenuity Project!

- Your sponsorship offsets the cost of student transportation, meals, teacher summer pay, space rental, and program materials for nearly **300** talented Baltimore City STEM students ages 12-18 this summer.
- Your sponsorship will be promoted to our online community of 3,000 cherished stakeholders through our newsletter with a 98% delivery rate and 55% open rate.
- Your sponsorship will be listed online and appear in Ingenuity's 2026 Annual Report.

## COMPLETE YOUR SPONSORSHIP TODAY!

*Note: Our 6th-grade Summer Academy remains fully funded through our partnership with Baltimore City Public Schools. Your donation directly impacts our new and expanded programs for older scholars.*

# Student Symposium Committees

New to this year's event are our Student Symposium Committees. A very special thanks to our students who were pivotal in planning and preparing for tonight's event! Their hard work and dedication over the last few months made tonight possible.

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Kenley Ravenna
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Shanti Powel
Reese Vallaincourt
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Edalia Campbell
Lexie Eblaghie
Hala Hassanein
Hajrah Refai

**Symposium Program Cover and Postcard Design**

Zoe Manning

# Acknowledgments

The Ingenuity Project and AP Capstone Pathway acknowledges the support of Poly's Administration, Baltimore City Public Schools, and the generous support of our entire community.

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**Our supporters maintain Ingenuity as the longest-standing advanced STEM program in Baltimore City. The Ingenuity Project would like to acknowledge the support of Baltimore City Public Schools and the generous support of the following foundations:**

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