The 62nd Annual Ohio Junior Science and Humanities Symposium



# CapitalUniversity Ask. Think. Lead.

Columbus, Ohio • February 28, 2025



*Junior Science and Humanities Symposium (JSHS) is a Department of Defense sponsored STEM program (U.S. Office of the Secretary of Defense and the U.S. Departments of the Army, Navy, and Air Force).* 

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## Welcome From Capital University's Provost

It is my privilege to welcome you to the 62<sup>nd</sup> Ohio Junior Science and Humanities Symposium!

Funding for JSHS is provided by the U.S. Army Research Office, U.S. Office of Naval Research, and U.S. Air Force Research Office. Through 48 regional symposia, JSHS brings together students throughout the United States, Puerto Rico, and DOD Schools in Europe and the Pacific.

Today's event showcases some of Ohio's most talented science, technology, engineering, and mathematics students to celebrate the work that they have accomplished. Through their research projects the student presenters demonstrate the skills and knowledge that they have gained inside and outside of the high school classroom. Two student finalists and three delegates from each regional JSHS program will be chosen to attend the National JSHS, which will be held in Chantilly, Virginia, from April 22nd through April 26th, 2025.

The presentations that you will see today are the result of hours of student work under the guidance of dedicated mentors. I offer a warm word of thanks to the teachers, scientists, and family members who have mentored these talented students. Your work with these students demonstrates the opportunities available to those who pursue careers in science, technology, engineering, and mathematics. Your willingness to nurture the interests of young scientists, engineers, and mathematicians is greatly appreciated.

Congratulations to each student presenter for your hard work and success.

Sincerely, Jody S. Fournier Capital University Provost

#### WELCOME FROM THE OHIO JSHS DIRECTOR

I am proud to welcome you to Capital University for the 62<sup>nd</sup> Ohio Junior Science Humanities Symposium! Thank you for taking the time and making the effort in this challenging world to come together to support the state of Ohio's students who have worked tirelessly with mentors, teachers, and in the world of academics to bring us the levels of research studies that have great potential to impact our world for the better.

I am especially humbled that in this time of uncertainty, students and mentors have been perhaps even more motivated to follow their research pursuits, and we are thrilled to have the chance to celebrate these achievements. I hope each student feels valued and confident about their achievements and that mentors feel supported and find an abundance of collaboration and camaraderie with like-minded peers. Families, we also extend to you a personal welcome to our campus, encourage you to be comfortable here, and to feel free to continue making memories with your students that you already have brought so far.

The JSHS program was founded by Ohio native, Colonel George F. Leist. After the 1958 launch of the Russian satellite Sputnik, Colonel Leist initiated the Junior Science and Humanities Symposium for secondary school students. From the first Symposium in 1958, to the 62<sup>nd</sup> in 2025, the Ohio Junior Science and Humanities Symposium continues to promote high standards and cutting- edge research, and to be a beneficial and educational experience. Now, more than ever, STEM education is critically important to our state, country, and planet. Thank you for joining us for this event!

Sincerely, Carmen Dixon Associate Professor of Education

# CapitalUniversity

# SCHEDULE OF EVENTS

8:30 am	Registration and Continental Breakfast	Capital Center Field House
9:30 am – 12:00 pm	Student Oral Presentations	Ruff Memorial Learning Center Classrooms
12:00 pm	Lunch and Keynote Address	Capital Center Field House
1:30 pm – 3:00 pm	Student Poster Session	Capital Center Field House
2:00 pm	Optional Campus Lab Tours	Depart from Capital Center Field House
3:00 pm	Closing Session and Awards	Capital Center Field House

# Keynote Address

# **DR. ELIZABETH YODER**

Dr. Yoder graduated from Capital University in May 2002 with majors in Biology/Pre-Medicine and French and shortly thereafter was commissioned as an officer in the United States Navy. She attended Ohio University College of Osteopathic Medicine and upon graduation, began active-duty military service.

Yoder was chosen as the Psychiatric Intern of the Year at Naval Medical Center Portsmouth in Portsmouth, Virginia and served as Co-Chief Resident. While stationed with the Marines at Camp Lejeune, North Carolina, Dr. Yoder initially served as the inpatient ward attending before deploying as the sole psychiatrist on the USNS COMFORT (T-AH 20) during the Continuing Promise 2011 humanitarian deployment to Central and South America.

Upon leaving active-duty service, Dr. Yoder moved home to New Albany, Ohio and began work as outpatient psychiatrist at Licking Memorial Health Systems in Newark, Ohio. At LMHS, she serves as the Chief of Behavioral Health Department and Vice Chief of Medical Staff. She was chosen as the hospital system's Physician of the Year in 2018. She is a Board of Trustee member for Licking/Knox Goodwill Industries, the Capital University Alumni Association Board, and the Ohio University Heritage College of Osteopathic Medicine Society of Alumni and Friends.

Dr. Yoder is a Distinguished Fellow of the American Board of Psychiatry and Neurology and serves as an Adjunct Clinical Professor for the Ohio University Heritage College of Osteopathic Medicine. She met her husband Grant on the first day of medical school and he also became a psychiatrist, thus ensuring that their two children will always have topics to discuss in therapy.



#### **STUDENT PRESENTATION SCHEDULE**

# Oral Presentations | 9:30 am – 12:00 pm

#### 9:30 am – 9:50 am

Laasya Acharya William Mason High School Implementing a Partial Least Squares Regression Model for the Precise Prediction of Soil Nutrients Based on Hyperspectral Reflectance Data

07 Ruff Memorial Learning Center

#### **Benjamin Bartyzel**

Saint Ignatius High School Do Gender Roles Affect How Teens Manage Stress and Maintain Wellness? 102 Ruff Memorial Learning Center

#### **Nikhil Bhimireddy**

Olentangy Orange High School Design and Testing of an Adjustable Functional Near-Infrared Spectroscopy (fNIRS) Cap 103 Ruff Memorial Learning Center

#### **Molly Chhabra**

William Mason High School Developing Shoulder Joint Replica to Study PPG Sensor Fidelity in Hypertension Monitoring 201 Ruff Memorial Learning Center

#### **Vedant Chhabra**

William Mason High School Improving Solar Cell Efficiency using AI/ML Models and Physics-Based Simulations 202 Ruff Memorial Learning Center

#### 9:55 am - 10:15 am

Irene Sun

Ottawa Hills High School Ultrasonic Degradation of Five Toxic Microcystin Congeners for Clean Water 07 Ruff Memorial Learning Center

#### Ethan Chan

University School Drink Me: A Study on the Effectiveness of Hydration Types on Athletic Performance 102 Ruff Memorial Learning Center

#### **Griffin Quigley**

University School The Turbine: A Combustionless Motor 103 Ruff Memorial Learning Center

#### **Ashley Chu**

Hathaway Brown School Development of Pre-clinical Assays for Quality Control of Cancer Imaging Agents 201 Ruff Memorial Learning Center

#### Arushi Dugar

Hathaway Brown School Neural Spike Sorting in the Primary Somatosensory Cortex 202 Ruff Memorial Learning Center

## 10:20 am – 10:40 am

Elena Zhu Upper Arlington High School A Computer-Generated Analysis of Live Cancer Cell Calcium Flux Oscillation 07 Ruff Memorial Learning Center

#### Manan Raina

Hawken School Global and National Burden of Type 2 Diabetes Mellitus Attributable to PM2.5 Air Pollution: An Analysis of the GBD Study from 1990-2019 102 Ruff Memorial Learning Center

#### Vaibhav Sampath

William Mason High School Polynomial Regression Machine Learning to Predict Stress-Strain Curves 103 Ruff Memorial Learning Center

#### **Rebecca Jacob**

Solon High School Explore Viability of Epileptic Seizure Prediction and Detection Using a Wearable Headset with Phone Alert Notifications 201 Ruff Memorial Learning Center

#### Neil Gera

William Mason High School Artificial Intelligence Road Hazard Object Recognition using Neural Networks (AIRHORNN) 202 Ruff Memorial Learning Center

# 10:45 am – 11:05 am

#### Sophia K. Wu

Columbus Academy Proteomics Analysis of Proteins Regulated by H2AX in Glioma Stem Cells 07 Ruff Memorial Learning Center

## **Kenley Routt**

Hilltop High School The Effects of Sound on Sleep 102 Ruff Memorial Learning Center

#### Adonis Wazni University School Biomimicry in Ship Hulls to Reduce Noise Pollution and Harmful Wakes

**Pollution and Harmful Wakes** 103 Ruff Memorial Learning Center

## Sahand Maleki

University School A Novel Role of Crimpy, a Drosophila IGFBP, in the Etiology of Neurodevelopmental Disorders 201 Ruff Memorial Learning Center

#### Niklas Rietsch

University School The Role of Primary Cilia in Parkinson's and Huntington's Disease 202 Ruff Memorial Learning Center

## 11:10 am - 11:30 am

Lina Tian Hathaway Brown School Characterization of Blood Vessel Formation After the KO of VPS35 in Astrocytes in the Developing Mouse Brain 07 Ruff Memorial Learning Center

Alex Zhang Centerville High School A Novel Nonmetallic and Biodegradable Hydrogel Treatment for Brain Aneurysms 102 Ruff Memorial Learning Center

#### Koyuki Yagi

Columbus School for Girls Evaluating the Effects of Laser Power and Travel Speed on Weld Penetration and Microstructure of Type 304L Stainless Steel 103 Ruff Memorial Learning Center

Elainie C. Theodorou Hathaway Brown School Association between Trigeminal Neuralgia and Degenerative Cervical Myelopathy: A Cross-Sectional Study using U.S. Data 201 Ruff Memorial Learning Center

Nandita Srikumar Solon High School EGCG: A Novel Therapeutic, Natural Product Inhibiting CDK5-Mediated Phosphorylation of CRMP-2 and Tau in Alzheimer's Disease 202 Ruff Memorial Learning Center

## 11:35 am – 11:55 am

Maya Tang Hathaway Brown School Aggregation and Cellular Localization Properties of Human and Murine M Cone Opsin 07 Ruff Memorial Learning Center

Gavin Sheppard University School Predicting Player Performance in Major League Baseball 102 Ruff Memorial Learning Center

#### Michael Zhu

University School Novel Flexible Substrate-Based 2D MoS2 Devices and Novel Ionic Liquid Gated MoS2 Field-Effect Transistors on Flexible Substrates 103 Ruff Memorial Learning Center

#### **Anshul Sharma**

University School A Novel Analysis on the Effects of Changes in the Social Vulnerability Index and its Subcategories on Changes in Survival Rates for Six Common Cancers from 2000-2020

201 Ruff Memorial Learning Center

# Poster Presentations | Capital Center Field House | 1:30 pm - 3:00 pm

#### Anushka Agarwal

Ottawa Hills High School Words and Walls: Analyzing German Language Integration Efforts for Immigrants

#### Sophia Almendras

Hathaway Brown School How do Anger and Fear Influence Adjustment to College? Looking at Proximal versus Distal Outcomes

#### Evan Dan

Solon High School Advanced Classification and Topic Modeling of Suicidal Ideation in Reddit Using Llama 3 and BERTopic

#### **Ritav Das**

Dublin Jerome High School The Effects of Solvation and Chirality on Polycatenanes

#### Lucas D'Cruz

University School Using Computer Vision to Identify Beech Leaf Disease at the University School Campus

#### **Devin Dempsey**

Hilltop High School Biodiversity Analysis- Effects of Water Proximity in Contrasting Seasons

#### Julia Dickinson

Hilltop High School Engineering and Product Testing an Effective Antiperspirant

#### **Mikey Fioritto**

University School A Comparison of Dental Implant Photogrammetry and Analog Jigs for Mapping Implant Location

#### **Carol Huang**

Hathaway Brown School Identification and Characterization of a Novel CAP Isoform in Adipocytes

#### Zaina Kamran

Summit Country Day School Investigating How Social Media Choice and Gender Impact Emotions and Social Media Scrolling Habits

#### Harman Kaur

Dayton Regional STEM School Exploring Paints to Delay Ice Nucleation of Airplanes, Wind Turbines, and Ships

#### Samantha Kayne

Indian Hill High School How Students from Different Economic Backgrounds View Criminal Records When Making Hiring Decisions

#### **Brock Kesler**

Hilltop High School The Effect of Blue Light on Sleep: A Two-Year Study of Factors Affecting Sleep Quality

#### **Brooklyn Kuszmaul**

Hilltop High School **The Inhibitory Effects of Antibiotics on E. coli K-12 with Varying pH Conditions** 

#### **Daniel Lee**

University School A Novel Mouse Model of Radiation-Induced Brain Injury

#### Shannon McNeeley Hathaway Brown

Hathaway Brown Wave Sensing for a Crab-Like Robot

#### **Brooke Moreland**

Hilltop High School Bacterial Growth Under Acrylic, Gel, Natural, and Polished Nails

#### Aditya Nalla

University School Examining Expression Patterns of the PDGFB Zebrafish Paralog Genes (PDGFBB and PDGFBA) when Pericyte Recruitment is Actively Happening

#### Sarah Neighbor

Saint Francis DeSales High School The Characterization of MHC Class I and II Molecules Among Laboratory Ferrets: A Comprehensive In Silico Analysis

#### **Allison Payton**

Zane Trace High School Water Bottle Heating

#### Manya Raina

Hathaway Brown School Renal Reserve Evaluation in Children with Severe AKI and MODS Undergoing Kidney Replacement Therapy

#### Sonia Robinson

Hathaway Brown School Quantum Information Science meets Mixed-Reality Technology through QuRIE (Quantum Realm for Immersive Education)

#### **Miracle N. Smith**

Hathaway Brown School School Curriculum, Policies, and Culture Around Climate Change

#### **Emily Stringer**

Hathaway Brown School What is the Effect of Decriminalized and Legalized Marijuana on Fatal Car Accidents?

### ABSTRACTS

#### Laasya Acharya, William Mason High School

Oral Presentation | 9:30 am | 07 Ruff Memorial Learning Center Iodel for the Precise Prediction of Soil Nutrients Based on Hyperspectral

# Implementing a Partial Least Squares Regression Model for the Precise Prediction of Soil Nutrients Based on Hyperspectral Reflectance Data

Globally food-demand is increasing; at the same time, soil-nutrient-deficiencies are a growing problem in agriculture. Predicting nutrientpercentages allows farmers to focus on bettering their soil to support crops and increase yields. Traditional soil testing-methods are often timeconsuming and extremely costly. The proposed-solution consists of a Partial Least-Squares Regression model combined with Ridge-regression to predict soil nutrient percentages based on spectral reflectance data. The dataset was into 80% for training and 20% for testing. Data was preprocessed using feature scaling and cross-validation was applied to optimize the number of latent components. The model was then run through the training stage, with an average R-squared value of 0.94 and a Root Mean Square Error value of 0.04. In the testing stage, the model was given data values it had not seen before to verify accuracy of the model. The model has a final R-squared value of 0.87 and a Root Mean Square Error value of 0.05. These values indicate that the model works efficiently when given new reflectance points. In conclusion, this project shows that a Partial Least Squares Regression model with Ridge-regression can be developed for prediction of nutrient-deficiencies, allowing for crop-yields to be increased and food demand to be met.

#### Anushka Agarwal, Ottawa Hills High School

Poster Presentation | 1:30 pm | Capital Center Field House

#### Words and Walls: Analyzing German Language Integration Efforts for Immigrants

Germany remains the top destination in the European Union (EU) for asylum seekers and refugees. As debate around immigration continues, the long-term effects settle in as immigrants integrate into German society. Though the German government has improved its integration course quality associating language proficiency with German identification, economic opportunity, and life satisfaction, immigrants still struggle to integrate because of inaccessibility and application of language to daily situations. The findings from this paper demonstrate the significance of target language proficiency for integration.

#### Sophia Almendras, Hathaway Brown School Poster Presentation | 1:30 pm | Capital Center Field House

#### How do Anger and Fear Influence Adjustment to College? Looking at Proximal versus Distal Outcomes

The transition to college is a critical period often known for its increased academic demands, new environments, and newfound independence, which leads to high vulnerability to mental health challenges. Fear and anger are known to influence emotional and academic adjustment; however, little is known about the impact of those particular emotions on freshmen during the transition to college. This study uses a mixed-methods approach with semi-structured interviews, self-reported affect ratings, facial expression analysis using Noldus Facereader, and the Symptom Checklist-90-Revised (SCL-90-R) to assess psychological distress amongst first-year students. Over two sessions, data was gathered from 117 first-year students at Kent State University throughout the academic year. The results showed that fear and anger were prominent emotions following distressing college experiences, with these emotions being significantly correlated with self-reported distress. Those who had higher psychological distress scores in the Fall semester had higher scores in the Spring as well. The findings of this study show the significant role of fear and anger in college adjustment and highlight the need for mental health interventions during this crucial time.

#### Benjamin Bartyzel, Saint Ignatius High School

Oral Presentation | 9:30 am | 102 Ruff Memorial Learning Center

#### Do Gender Roles Affect How Teens Manage Stress and Maintain Wellness?

This study investigates gender differences in preferred wellness activities among high school students. Three research questions were addressed: (1) Is there a gender difference in how teens perceive stress and necessitate sleep? (2) Is there a gender difference in subjects' rating their energy level after engaging in wellness activities? (3) Is there a gender-based preferred wellness activity? The hypothesis is that a statistically significant difference exists between male and female high school students in their perceived stress and reported energy after engaging in eight wellness activities. 386 students from 2 single-sex Catholic high schools in Northeast Ohio participated in the wellness survey. The coping mechanisms surveyed included sleeping, engaging in indoor exercise, engaging in outdoor exercise, using a digital device, enjoying social activities, attending church, doing yard work, listening to or playing music, and engaging in arts and crafts. Results suggest that a gender difference exists in the preferred activity as measured by reported energy levels after engagement. While both genders rated most of the activities similarly, three activities (digital device, yard work, and music) showed a significant statistical difference, with males reporting higher energy levels after engaging in these activities, music and outdoor exercise. This study suggests gender-based wellness programs can be designed to emphasize social gathering for both groups; additionally, music and sports for male students, indoor exercise and arts and crafts for female students.

#### Nikhil Bhimireddy, Olentangy Orange High School

Oral Presentation | 9:30 am | 103 Ruff Memorial Learning Center

#### Design and Testing of an Adjustable Functional Near-Infrared Spectroscopy (fNIRS) Cap

Functional near-infrared spectroscopy (fNIRS) is a widely used neuroimaging tool valued for its non-invasive nature, portability, and versatility across diverse populations. However, its effectiveness is often limited by fixed-size caps, such as the EasyCap, which use rigid 2cm interval sizing. These caps increase logistical and financial burdens, require frequent rewiring between trials, and fail to provide a tailored fit, resulting in participant discomfort, compromised data quality, and inefficiencies in research and clinical settings. To address these challenges, an adjustable fNIRS cap was developed, featuring a 360-degree dial-lacing mechanism and custom 3D-printed components for precise, modular sensor placement. This innovative cap adapts to participants with diverse head circumferences, hair types, and skin tones, eliminating the need for multiple fixed-size caps. Its performance was evaluated in a study with 15 participants, using the average signal quality measured by the percentage of Green channels from calibration map visualizations. The adjustable cap achieved a Green signal rate of 82.30%, significantly outperforming the EasyCap's 45.45%. It demonstrated a 24.20% higher Green signal rate for Skin Tone 5 (Fitzpatrick Scale) participants and a 55.77% improvement for those with thicker hair. Additionally, it reduced setup times from 25–30 minutes to seconds, minimized motion artifacts, and enhanced participant comfort during extended sessions. By addressing key limitations of traditional fNIRS caps, this adjustable cap shows strong potential to improve efficiency, inclusivity, and data quality in neuroimaging. Further refinement of prototypes and expanded research will support its development into a standard solution.

#### Ethan Chan, University School

#### Oral Presentation | 9:55 am | 102 Ruff Memorial Learning Center

#### Drink Me: A Study on the Effectiveness of Hydration Types on Athletic Performance

Optimal athletic performance requires ample oxygen in muscle tissue for energy production, sustained activity and delaying fatigue. This study examines how different hydration types affect muscle oxygen levels (SmO2) during a standardized 2-mile run to determine whether commercially available performance drinks are better for peak performance compared to water. Four hydration types will be examined: water, Gatorade, Pedialyte, and ionized water. Hydration types will be randomized prior to the run and total hydration regulated, with the participant consuming a total of 1.2 liters of the selected hydration within 3 hours prior to the run. Study participant will run 2 miles at a 6:45 minute per mile pace on a treadmill wearing a Moxy5 muscle oxygen sensor on the vastus lateralis of the dominant leg. Data collected was partitioned into 3 phases: warmup, run, and cool down. The results of the study showed that SmO2 levels drop dramatically during the run as expected and during cool down returns to levels comparable to levels during warmup. Interestingly, none of the hydration types resulted in a significant difference in muscle oxygen during any of the phases when compared to water or each other. Preliminary results suggest that with ample hydration prior to exercise, the type of fluid intake makes little difference. Further research with increased sample size and datapoints will provide more conclusive evidence. Additionally, a follow up study will examine whether hydration types make a difference in individuals who are under hydrated.

#### Molly Chhabra, William Mason High School

Oral Presentation | 9:30 am | 201 Ruff Memorial Learning Center

#### Developing Shoulder Joint Replica to Study PPG Sensor Fidelity in Hypertension Monitoring

Hypertension is a leading cause of cardiovascular disease, contributing to strokes, heart attacks, and kidney failure worldwide. Wearable devices using photoplethysmography (PPG) provide an opportunity for continuous, non-invasive BP monitoring, but their accuracy is affected by motion artifacts from the daily activities. The current research focused on designing and building a spherical parallel manipulator (SPM) to replicate the biomechanics of the human shoulder. SPMs, with their three degrees of rotational freedom, were chosen for their ability to precisely emulate complex shoulder motions. The work process included computer aided design (CAD) modeling, finite element modeling (static load and buckling analysis), iterative refinements, and the creation of a functional prototype. The parts were 3D printed and assembled at Purdue University's BioCom lab, where the SPM was connected to three motors and an Arduino controller to enable 3D motion. The motion fidelity was tested for replication of human shoulder movements when integrated into a humanoid arm system. This SPM-enabled humanoid arm would provide a controlled platform to study motion artifacts in PPG-based BP monitoring. By replicating thousands of movements in the next phase of research, the system would be able to generate comprehensive datasets to train AI models to filter out motion-induced distortions.

#### Vedant Chhabra, William Mason High School

Oral Presentation | 9:30 am | 202 Ruff Memorial Learning Center

#### Improving Solar Cell Efficiency using AI/ML Models and Physics-Based Simulations

Solar cells are becoming the fastest growing sustainable energy source. However, they suffer from low efficiency. Perovskite solar cells are emerging technology to resolve low efficiency of solar cells. A unique approach combining machine learning (ML) with physics-based simulations was researched to optimize perovskite solar cell (PSC) efficiency. This study focused on maximizing Power output (POUT), a parameter directly linked to efficiency. A comprehensive dataset, using 1-D drift-diffusion simulations and encompassing various design features and corresponding POUT values, was taken from the literature. This data was used to train ML models capable of predicting POUT with high accuracy and identifying the most influential design factors. The analysis showed that interface and grain boundary defect densities were the most significant efficiency limiters, far more than other properties like doping and mobility. An iterative process of ML model-based optimization was implemented. This approach significantly accelerated the efficiency improvement process by reducing dependence on computationally expensive simulations. Subsequently, a generative AI/ML simulator was employed to explore these optimized designs virtually, further accelerating discovery of high-performing PSCs. Overall, this research established a rapid and data-driven framework for PSC design optimization, highlighting the potential of AI/ML to improve efficiencies in real-world applications.

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#### Ashley Chu, Hathaway Brown School

#### Oral Presentation | 9:55 am | 201 Ruff Memorial Learning Center

#### Development of Pre-clinical Assays for Quality Control of Cancer Imaging Agents

Glioblastoma, the most common primary brain tumor, is incredibly invasive, making it very difficult to fully remove with surgery. The receptor protein tyrosine phosphatase PTPµ is a homophilic cell-cell adhesion molecule (CAM) and an enzyme. PTPµ is specifically cleaved in tumor tissue, generating fragments that can bind to fluorescently conjugated peptides, outlining the tumor mass and margins for enhanced surgical resection. The goal of this study is to find a suitable in vitro assay that detects peptide interaction with the PTPµ biomarker in hopes that it will help identify the best peptides for in vivo glioblastoma imaging agents. Using a bead aggregation assay to assess buffers' effect on peptide- protein interactions, we found that different medias and pH may affect aggregation and potentially conditions used for peptide-protein binding. Moving on to a fluorescent bead binding assay, we sought to identify optimal peptide-PTPµ binding conditions with two PTPµ-specific peptides, SBK2 and SBK4. SBK4 bound strongly to PTPµ in vitro, but SBK2 bound similarly to the control protein (NCAM\_fc). However, when analyzing protein coating densities, western blots revealed less PTPµ\_fc than NCAM\_fc on beads. We can theoretically use this data to normalize the peptide experiment results. Upon normalization, SBK2-binding to PTPµ\_fc showed some specificity, but further experimentation should be done with similar protein bead coating densities. More buffers and peptides will also be tested to find the best peptide-PTPµ binding conditions to use as an in vitro test for the quality of the imaging agents.

#### Evan Dan, Solon High School

#### Poster Presentation | 1:30 pm | Capital Center Field House

#### Advanced Classification and Topic Modeling of Suicidal Ideation in Reddit Using Llama 3 and BERTopic

Suicide remains a critical global health issue, with over 700,000 lives lost annually. Existing research has explored thematic patterns associated with suicidal thoughts, but traditional studies often rely on small-scale data sources that may overlook contextual influences. This study aims to address that gap by analyzing a large dataset of posts from Reddit communities r/SuicideWatch and r/Teenagers for analysis. Using Key Word in Context analysis allows for an in-depth examination of the language and contextual patterns. Using Reddit posts, the Llama 3-8b and Mistral-7b models were fine-tuned with manually labeled data for enhanced classification accuracy for suicidal ideation. Using BERTopic, key themes linked to suicidal ideation were identified: relationship struggles, academic stress, and family trauma. While non-suicidal posts also included social and academic concerns, the topics were centered around more immediate stressors rather than the long-term emotional distress issues seen in the suicidal group. Intertopic distance maps and similarity matrices revealed how family trauma impacts future relationships and academics while critical life events are associated with personal struggles and suicidal thoughts. These findings highlight the potential of NLP methodologies in analyzing large-scale social media data, offering valuable insights for informing new prevention strategies. Additionally, social media, in combination with NLP, serves as a valuable outlet for capturing genuine emotional struggles, enabling more timely and personalized mental health support compared to traditional approaches like counseling.

#### Ritav Das, Dublin Jerome High School

Poster Presentation | 1:30 pm | Capital Center Field House

#### The Effects of Solvation and Chirality on Polycatenanes

Polycatenanes, a family of mechanically interlocked molecules, have distinctive structural features under chirality control and solvation interactions, and they are promising molecules for future nanotechnology, drug delivery, and molecular machine applications. Herein, the influence of solvent favorability and chirality on structural features of polycatenanes is explored by molecular dynamics simulations. Three chiral conformations—alternating chirality (Alt), saddle-like (B Formation), and planar (C Formation)—were studied in various solvent conditions modeled by an implicit solvent model in LAMMPS. Solvent interaction directionality was controlled through manipulation of the epsilon parameter, whereas collapse extent of the molecule was determined by mean squared distance (MSD) calculations. The findings revealed that the Alt structure was most resistant to structural collapse, with an open conformation even in the least favorable solvent condition. The B Formation was moderately susceptible to collapse, while the C Formation was most compressible, particularly in the presence of unfavorable solvents. The findings suggest that chirality plays an important role in the stability of polycatenanes and that alternating chirality leads to higher structural stability. This study highlights the interplay between chirality and solvent interactions, providing astute observations into the dynamics of polycatenanes, with a consideration of molecular design and environmental conditions being essential to the development of materials.

#### Lucas D'Cruz, University School

#### Poster Presentation | 1:30 pm | Capital Center Field House

#### Using Computer Vision to Identify Beech Leaf Disease at the University School Campus

Beech leaf disease (BLD) has many severe negative effects on the environment and economy. BLD is a highly infectious disease that infects all nearby beech trees, killing up to 90% within 7 years. A primary obstacle in BLD prevention is detecting the disease before it infects a full population. A dataset of over 1,000 images of beech leaves was created, edited, and categorized into the categories no BLD, early BLD, and late BLD. I trained an artificial intelligence (AI) based image categorization model to detect beech leaf disease which was trained on 956 images from the dataset. The accuracy and precision of BLD classification were compared between the AI model and an untrained group of humans in a 100-image test. I hypothesized that my AI model would more accurately determine BLD presence than an untrained human because of its pattern recognition skills. The human group was unassisted – using only prior knowledge of leaf diseases. Over 5 tests, the AI determined if the image had BLD (yes/no) and the extent of disease (early/late) with an average accuracy of 73.6% while the human group only had 59.0% accuracy. The AI model was also more precise in its categorization than the humans, with 92.2% precision, compared to the human's 71.8%. These results show that my AI model is more accurate than untrained humans at detecting BLD, suggesting it may be useful to help humans detect and control the harmful effects of BLD in the future.

## Devin Dempsey, Hilltop High SchoolPoster Presentation | 1:30 pm | Capital Center Field House

#### Biodiversity Analysis- Effects of Water Proximity in Contrasting Seasons

Water is required by almost every living thing to survive and is one of the staples of life. This project aims to identify how a water source affects biodiversity. Biodiversity is extremely important to an ecosystem because it allows that ecosystem to run as a system and thrive. The outcome of this experiment could provide information that implementing more water sources could be beneficial to the overall success of wildlife. The hypothesis of this project was that the area with a water source would have more biodiversity than the area without a water source. Two trail cameras were set up in two different wooded locations. One location had a small pond, and the other did not. The cameras were checked once every week and recorded onto a notepad and later put into a Google Doc. The data was recorded by taking the SD cards out of the cameras and using an adapter to show the photos on an iPhone. The data was recorded by species, and then the number of them was recorded. The first hypothesis was statistically supported. In one year, a total of 333 animals were observed by the water source cameras compared to only 171 tracked in the non-water environment (p = .0024). The second hypothesis was not supported. Although summer showed more animals present (water-110, no water- 41) than fall (water- 94, no water- 43), these differences were not statistically significant.

#### Julia Dickinson, Hilltop High School

Poster Presentation | 1:30 pm | Capital Center Field House

#### Engineering and Product Testing an Effective Antiperspirant

The purpose of this experiment was to test two different main ingredients, a fragrance, and four combinations most commonly found in deodorants: aluminum chlorohydrate(AC), oregano essential oil(OES), and a vanilla fragrance(VF). The combinations consisted of AC+OES, AC+VF, OES+VF, and AC+OES+VF. These active ingredients and various combinations were then tested on E. coli K12 for rings of inhibition. Engineering design testing consisted of using the ingredient combination that produced the largest ring of inhibition, creating a homemade antiperspirant. After formulating the product, it was applied to the forearm of 6 test subjects to evaluate skin redness, rashing, and itchiness. Aluminum chlorohydrate suppressed the most *E. coli* with an average ring of 17mm. Part two consisted of ring inhibition testing that did not show any larger rings than the aluminum chlorohydrate did from part one. The next most effective ingredient combination was OES+VF with an average ring of 8.8mm. From Part 3 testing, the subjects did not report any signs that the oregano essential oil-based product caused any major skin irritation. Part 1 hypothesis was not supported. The AC had significantly larger rings of inhibition averaging 17mm when compared with OES at 2.3mm (p = .0001). When the OES was compared to VF (.16mm), OES was significantly larger (p = .0001). In part 2 of testing, four of the OES combinations showed significantly greater bacterial inhibition (p = .0001). An antiperspirant was then successfully created from part 1 and part 2 results. This product passed the first phase of product testing with no reported itchiness, redness, or rashing. Additional product testing is being conducted.

#### Arushi Dugar, Hathaway Brown School

Oral Presentation | 9:55 am | 202 Ruff Memorial Learning Center

#### Neural Spike Sorting in the Primary Somatosensory Cortex

The recording of neuronal action potentials from multiple neurons in humans has been a notable advancement for better understanding the nervous system. When our sensory nerves are activated, either via touching an object or stimulating the nerve using peripheral nerve stimulation (PNS), we feel a sensation. This sensation is caused by a signal in the form of action potentials being relayed from our fingers to our brain. However, in order to determine if a neuron is part of the PNS pathway we have to use Spike Sorting to filter out all background noise and find single neuron activity. When an 8 X 8 microelectrode array is placed in the primary somatosensory cortex (S1), each electrode can record when nearby neurons fire an action potential in response to the stimuli. However, since electrodes may receive feedback from more than one neuron, it is difficult to determine the behavior of individual neurons. A technique known as spike sorting is used to cluster neuronal spikes depending on their shape to determine which neurons they were recorded from. We collected multi-unit recordings from an experiment where PNS was delivered and then sorted them using a spike sorting interface. Automatic sorting and manual inspection were performed to attain single-unit activity from the recordings. After being sorted, the single units were visually inspected to determine if their firing pattern resembled the behavior of different somatosensory fibers. With this information we can understand how the brain processes sensation elicited by PNS.

# CapitalUniversity

#### Mikey Fioritto, University School

Poster Presentation | 1:30 pm | Capital Center Field House

#### A Comparison of Dental Implant Photogrammetry and Analog Jigs for Mapping Implant Location

Currently, there are two ways to record the location of implants that support complete arch prostheses--digital photogrammetry and analog verification jigs with a master cast. This study aims to compare the two methods and how they record positional diGerences of implants. To find the implant positions using photogrammetry, a PIC scan was taken in the patient's mouth. For the same patients, a verification jig was handmade and used to make a master cast. A PIC scan was then taken of that master cast in order to have an easy way to compare implant locations digitally. Finally, all the data was imported into Cloud Compare, overlaying the two scans. A graph and an image with the mean and standard deviation of each scan's positional change to each other were also generated from this data. There is no current study comparing these two variables to each other, and that is what this study is aimed to fill. Though there is no study like this, there is a study that compares the accuracy of diGerent digital acquisition methods in complete arch implant supported prostheses in vitro. The results of that study show statistically significant diGerences were detected between the diGerent digital devices. That is similar to the results I have found in my study, where there is also a diGerence between the patient photogrammetry scan and the verification jig. This diGerence is significant because it is over the set 120µm maximum, which would indicate significant positional change. 50µm is the ideal positional change, and anything under it is excellent.

#### Neil Gera, William Mason High School

Oral Presentation | 10:20 am | 202 Ruff Memorial Learning Center

#### Artificial Intelligence Road Hazard Object Recognition using Neural Networks (AIRHORNN)

Self-driving cars are becoming increasingly popular and yet there is limited knowledge on how to detect road hazards, especially on rural roadways, making them a safety vulnerability. I propose an additional model that can be easily added to existing black box self-driving algorithms to improve driver safety, prevent serious injury crashes or fatal accidents. In this proof-of-concept, over 665 existing images of potholes and sinkholes were used to train the convolutional neural network (CNN) model using a T4 GPU. It took 6 minutes on a T4 GPU (6 hours on a CPU machine) to train the model with a validation loss of ~30 (lower is better). In addition, another safety vulnerability is in how the model perceives the roadway; artificial optical illusions or road art can trick computer vision models and bring traffic to a complete standstill. This adversarial application exposes the vulnerability of inadvertently including such fabricated images or attempting to replicate these images to take advantage of model detection weaknesses for nefarious purposes.

#### Carol Huang, Hathaway Brown School

Poster Presentation | 1:30 pm | Capital Center Field House

#### Identification and Characterization of a Novel CAP Isoform in Adipocytes

The primary form of glucose regulation in adipocytes is GLUT4 translocation resulting from insulin stimulation. The majority of this function is mediated by the PI3K pathway, despite some previous studies identifying a PI3K-independent pathway. The TC10 pathway and its member protein CAP have been suggested to play a part in these PI3K-independent effects of insulin stimulation. However, their involvement is debated as numerous studies over the past few decades have both replicated as well as failed to replicate these findings, leading to CAP's controversial status in the field of adipocyte biology. Using Next-Gen Sequencing datasets and validation using protein isolates from in vitro samples, we've identified a previously unknown isoform of CAP that may resolve inconsistencies in the field of adipocyte biology.

#### Rebecca Jacob, Solon High School

Oral Presentation | 10:20 am | 201 Ruff Memorial Learning Center

#### Explore Viability of Epileptic Seizure Prediction and Detection Using a Wearable Headset with Phone Alert Notifications

Epilepsy, a brain disorder causing recurring seizures, affects approximately 65 million people worldwide, making it one of the most common neurological diseases. Additionally, epilepsy severely reduces individuals' quality of life, with a disability-adjusted life year (DALY) of 0.657– where 1 represents full disability–, indicating a substantial reduction in health (Mehndiratta & Wadhai, 2015). My research explores the extent to which machine learning can be used to predict seizures in real time and warn patients or caregivers of imminent seizures. Using two datasets— CHB-MIT and Siena Scalp EEG—comprising 1160 hours of data from patients aged 0.5 to 71 years, I trained four models for seizure detection (K-Nearest Neighbors, Logistic Regression, Random Forest Classifier, Support Vector Machine) and one for prediction (Long Short- Term Memory). Evaluation metrics, including accuracy, recall, precision, and F1-score, showed a detection accuracy of 98.67%. Subsequently, I integrated my model with a wearable EEG headset (Muse) and developed a web app that successfully predicts seizures 5 minutes ahead of time, with 84.54% accuracy. This work demonstrates the potential of machine learning to enhance seizure prediction and improve patient safety.

#### Zaina Kamran, Summit Country Day School

Poster Presentation | 1:30 pm | Capital Center Field House

#### Investigating How Social Media Choice and Gender Impact Emotions and Social Media Scrolling Habits

Body dysmorphic disorder (BDD) is a mental illness that continues to increase in incidence among adolescents. Additionally, more and more young adults are exposed to social media where there are many edited photos that can create a feeling of insecurity for the audience viewing the edited photos. We asked whether the frequency of social media usage or gender affects the adolescent's social media habits and emotions they feel when scrolling, posting, and after they are done using the app. The goal of this study was to see if a relationship exists between adolescents who use social media often or gender and the type of emotions they experience when on social media or after they use it. Using a survey, 103 adolescents self-reported their social media and image editing habits. The most used app among the participants was Instagram (90%), and 67% used social media every day. While we surveyed Instagram, Facebook, Tik Tok, Snapchat, and BeReal we only used the data from Snapchat, Tik Tok, and Instagram since these apps are currently the most prevalent social media apps among adolescents. We then asked participants to identify how they felt after they posted an image on any social media. No significant difference was found between usage of social media apps or gender and the proportions of negative emotions experienced along with scrolling habits on social media. This study revealed that choice of social media platform does not impact adolescent emotion, and no difference exists between male and female respondents. Limitations with the study were identified and reveal what improvements can be made to the survey. Lastly, this study also reveals the lack of existing research to examine the correlation between social media usage and BDD.

#### Harman Kaur, Dayton Regional STEM School

Poster Presentation | 1:30 pm | Capital Center Field House

#### Exploring Paints to Delay Ice Nucleation of Airplanes, Wind Turbines, and Ships

Recent aviation data suggests that the icing has been responsible for 35% of weather-related plane accidents (the largest cause) and around a fifth of weather-related fatalities in the past century. Airplane icing is the buildup of ice on the leading edges or front surfaces of the plane. This phenomenon, known as ice nucleation, is not only observed on airplanes, but also wind turbines and ships. For my project, I plan to evaluate different types of paints on aluminum surfaces (to mimic airplanes exposed surfaces) to evaluate how different varieties of paints affect the nucleation of ice on aluminum (mimicked) surfaces. My research question is focused on identifying the correlation between hydrophobic (water-repellent) nature of different paints and delay in ice nucleation. My hypothesis is that paints with a higher contact angle (more hydrophobic surface) will delay ice nucleation the longest. To evaluate my hypothesis, I created an artificial environment using a freezer and water and the natural environment with snow. I collected data on each painted aluminum sheet's contact angle and ice buildup. On average, the contact angle for the paints were 56.6 degrees and the average for the ice buildup were 0.234g (over the contact time of ~8 hrs) on 2 X 2 inch aluminum surfaces. In conclusion, my hypothesis was proved partially right, that higher contact angles do delay ice nucleation. This experiment can help engineers and chemists design and create a modern solution that performs better in harsh environments such as ice, freezing rain, and wind.

#### Samantha Kayne, Indian Hill High School

Poster Presentation | 1:30 pm | Capital Center Field House

#### How Students from Different Economic Backgrounds View Criminal Records When Making Hiring Decisions

Criminal record holders face many barriers to successful integration into society, including difficulty obtaining employment. Previous research has identified that the stigma surrounding criminal records strongly negatively influences hiring decisions. However, prior studies have not compared the views of employers from different socioeconomic backgrounds. This paper explores whether students from school districts with different average income levels have different perspectives on the significance of a nonviolent criminal record when making hypothetical employment decisions. I distributed a mixed-method survey to two different student populations: a school district with a high median household income and another with a significantly lower median household income. The quantitative portion of the survey used a Likert scale that had respondents answering questions about the employability of a person with a nonviolent criminal record based on four categories: nondescript, professional attributes, crime-specific, and context of job function/industry. A chi-squared test established a statistically significant difference between the two groups' responses to the nondescript question, while the other three categories were used to investigate the complexities of that finding. Next, the qualitative portion of the survey used an open-ended question and was analyzed using a thematic analysis, revealing differences in themes. I concluded that, while both schools have a significant portion of students who would not hire criminal record holders, in general, students from the school district with the lower median household income had greater concerns and were less likely to hire someone with a nonviolent criminal record than students in the higher-income school district.

#### Brock Kesler, Hilltop High School

#### Poster Presentation | 1:30 pm | Capital Center Field House

#### The Effect of Blue Light on Sleep: A Two-Year Study of Factors Affecting Sleep Quality

The first hypothesis for this experiment was that the more blue light that participants were exposed to before bed, the worse the participants' sleep quality would be. The statement "worse sleep quality" means that the participant would be in deep sleep less than they are in light sleep. This hypothesis was not statically supported. The participants that were exposed to blue light until bed were in deep sleep less than light sleep. The average time spent in deep sleep with blue light exposure until bed was 39.6%. The group that put down devices one hour before bed spent 46.8% of the night in deep sleep. The group that put the devices down two hours before bed averaged 49.2% of the night in deep sleep. These differences were not statically different. The second hypothesis for this experiment is that the more blue light you are exposed to, the longer it will take the participants to fall asleep. This hypothesis was also not statically supported. The average time to fall asleep was eight minutes for blue light the participants were exposed to, the less total sleep the participants would get. This hypothesis was partially supported. The group that had the devices up until bed averaged 437.4 minutes, two hours before bed averaged 430 minutes, and less than one hour before bed averaged 455.6 minutes. In this experiment, increasing blue light exposure showed a trend of more time to fall asleep, more time spent in light sleep and less time in deep sleep. Although the small subject size did not statistically show significance, this trend is worthy of additional testing.

#### Brooklyn Kuszmaul, Hilltop High School

#### Poster Presentation | 1:30 pm | Capital Center Field House

#### The Inhibitory Effects of Antibiotics on E. coli K-12 with Varying pH Conditions

The objective of this project was to evaluate the impact of varying pH conditions on the efficacy of three antibiotics. By quantifying the average inhibition zones, this project aimed to discern how pH influenced antibiotic activity and any possible relationships between pH and antibiotic efficacy. The methodology involved preparing nutrient agar in Erlenmeyer flasks, autoclaving the mixture, and pouring it into petri dishes. For the varying pH conditions, pH buffers were added to the nutrient agar mixtures before autoclaving. After the dishes were set up *Escherichia coli* K-12 was inoculated onto the surface of the agar, and three antibiotic disks were onto each plate. These dishes were incubated for 48 hours at 37°C. Following incubation, the inhibition rings were measured, averaged, and the data was analyzed using unpaired t-tests. The first hypothesis was supported as ciprofloxacin had significantly larger rings of inhibition at 9.4mm compared to amoxicillin with clavulanic acid at 7.6mm (p = 0.0141) and sulfamethoxazole with trimethoprim at 3.0 mm (p = 0.0007). The second hypothesis was partially supported. In the neutral pH trials ciprofloxacin had significantly larger rings of inhibition at 12.5mm compared to amoxicillin with clavulanic acid at 8.0mm ( $p \le 0.0001$ ) and sulfamethoxazole with trimethoprim at 9.2mm ( $p \le 0.0001$ ). In the acidic pH trials ciprofloxacin had a larger ring of inhibition at 10.9mm. The ciprofloxacin did have significantly larger rings than sulfamethoxazole with trimethoprim at 8.9mm (p = 0.0002). The alkaline pH resulted in no bacteria growth and therefore no data from those trials. The third hypothesis was refuted as the acidic trials had a larger average ring of inhibition at 10.6mm, but this was not statistically different from the neutral trials at 9.9mm.

#### Daniel Lee, University School

#### Poster Presentation | 1:30 pm | Capital Center Field House

#### A Novel Mouse Model of Radiation-Induced Brain Injury

Radiation therapy is an integral part of treatment for patients with brain cancers. Radiation-induced brain injury (RIBI) occurs in over 50% of patients. RIBI is characterized by cognitive and physical deficits such as memory loss, dementia, and ataxia. There are no effective treatments for RIBI. The molecular mechanisms underlying RIBI are not well understood, but they are thought to involve radiation-induced DNA damage and oxidative stress, which damage brain cells. Apurinic/apyriminidinic endonuclease 2 (APE2) is a DNA damage repair protein induced by radiation therapy. We developed transgenic APE2 transgenic mice as a new mouse model of RIBI. We showed that transgenic Ape2 mice develop neurologic deficits mimicking RIBI. I quantified MR images of mouse brains to calculate the volumes of each part of the brain (brain, outer cortex, cerebellum). I found that the APE2 transgenic mice had smaller overall brains, outer cortex, and cerebellums, than the control mice, mirroring that of RIBI patients. Our data support that the APE2 transgenic mice may be good models of RIBI and provide new insights on the molecular mechanisms that contribute to RIBI.

#### Sahand Maleki, University School

#### Oral Presentation | 10:45 am | 201 Ruff Memorial Learning Center

#### A Novel Role of Crimpy, a Drosophila IGFBP, in the Etiology of Neurodevelopmental Disorders

Autism Spectrum Disorder (ASD) is a condition that results from neurodevelopmental delays and often presents as cognitive, social, communicational, and behavioral challenges. Currently, up to 1 in 36 American children suffer from ASD, making research into potential factors incredibly important, as its root causes are largely unknown. In the past, Drosophila melanogaster have been used to study the genetic factors leading to a variety of conditions stemming from neurodevelopmental delays. For this study, the relationship between Crimpy, a novel Drosophila insulin-like growth factor binding protein (IGFBP), and the presence of obsessive grooming behaviors in Drosophila –an indication of neurodevelopmental delays– was studied. It was also tested whether the absence of Crimpy as a whole or just in certain Insulin-like Growth Factor (IGF) producing neurons would have a significant impact on obsessive grooming behavior compared to wild-type Drosophila. Three groups of Drosophila were recorded, and their behavior was analyzed at three different ages: 1 day old, 10 days old, and 25 days old. The data supported the hypothesis stating that the Drosophila lacking Crimpy altogether, as well as just in the IGF-producing neurons, demonstrated more obsessive grooming behavior than wild-type Drosophila in all measured metrics, suggesting the presence of neurodevelopmental delays. This study helps to reveal the vital role that IGFBPs play in neural development. This also presents opportunities for future research to investigate the role of similar proteins in humans to uncover potential risk factors for neurodevelopmental conditions such as ASD.

#### Shannon McNeeley, Hathaway Brown

Poster Presentation | 1:30 pm | Capital Center Field House

#### Wave Sensing for a Crab-Like Robot

Beach and underwater terrain is a difficult area for robots to traverse. Looking at nature for inspiration, crabs have been able to thrive in this environment for many years. The Crab Lab at Case Western Reserve University has created a crab robot that is able to traverse this type of terrain. These Crab Robots are able to sense unidentified exploding ordinances (UXO) and extract them from sandy areas, keeping beaches safe from environmental destruction. However, waves and depth changes can often lead to difficulty in navigation and steering of the robot. Furthermore, current depth sensors are not suitable for shallow water and small robot platforms. Therefore, we are developing new wave sensing techniques for underwater legged robots. Characterizing the waves in real time is an important aspect of accomplishing this transition. Using sensing dactyls and pressure sensors that are integrated into the robot itself, the strength and height of waves can be sensed. We mounted LPS35HW pressure sensors on a testing platform and lowered the device into a wave tank to compare measurements against ground truth, which we determined through video tracking. LPS35HW sensors provide accurate depth measurements with little processing power. More testing will be done in realistic surf zone environments including a wave tank with artificial waves and real outdoor environments.

#### Brooke Moreland, Hilltop High School

Poster Presentation | 1:30 pm | Capital Center Field House

#### Bacterial Growth Under Acrylic, Gel, Natural, and Polished Nails

The goal for this project was to expand upon last year's experimentation on bacterial levels in acrylic and natural fingernails. This year the goal was to determine if acrylic nails harbored more bacteria compared to gel, polish, and natural nails. Many people claim that acrylic nails contain more bacteria and fungi than any other nail type. This is why people who work in health careers cannot wear artificial nails, and other professions also have regulations on what type of nails can and cannot be worn. The hypothesis of this experiment was that acrylic nails would contain more bacterial growth when compared to the other three nail types. Twenty participants, five with acrylic nails, five with gel nails, five with polished nails, and five with natural nails. Were swabbed under their nails over the course of two days. Nail length was also measured. The swabs were inoculated onto nutrient agar petri dishes which were incubated for 48 hours at 37C. Colony forming units (CFUs) and percent of growth coverage were measured, and the averages were compared using unpaired t-tests. The average amount of CFUs for acrylic nails was 7.6 compared to gel at 51.1, natural at 125, and polished at 193.4. However, this difference was only significantly significant for acrylic vs. polished nails (p = .0152). This is the only factor that partially supports the hypothesis. The percentage of bacterial dish coverage for acrylic nails was 92.9% compared to gel at 78.75%, natural at 70.45%, and polished at 50.3%. Results showed that acrylic nails had a statistically higher coverage percentage when compared to polished nails (p = .0029), but not the other nail types. This data refutes the hypothesis along with gel and natural nails with no supporting evidence.

# Aditya Nalla, University School Poster Presentation | 1:30 pm | Capital Center Field House Examining Expression Patterns of the PDGFB Zebrafish Paralog Genes (PDGFBB and PDGFBA) when Pericyte Recruitment is Actively Happening

The vascular system delivers oxygen and nutrients to cells, and it consists of many endothelial cells, which regulate exchanges between the bloodstream and surrounding tissues. Pericytes are cells that wrap around endothelial cells, have a major role in vascular stability and function, and are recruited to blood vessels through the pdgfb-pdgfrb signaling pathway. However, in the zebrafish vasculature – a vasculature similar to that of a human and of other vertebrates – there is a striking heterogeneity of pericyte recruitment to blood vessels. This research aimed to explore the relationship between the mRNA expression of pdgfbb and pdgfba genes and the distribution of pericyte recruitment to four different blood vessels in the zebrafish vasculature: PCeV, MCeV, DLV, and MSV. An RNAScope assay and confocal microscopy were used to quantify the mRNA expression in those four blood vessels in the zebrafish vasculature. The results showed that mRNA expression was highest in the MSV, followed by the DLV, MCeV, and PCeV. The mRNA expression and the pericyte distribution in the MSV showed a strong correlation, with both having a high expression. The mRNA expression and the pericyte distribution in both the DLV and MCeV had less of a correlation than that in the MSV, and they had almost no correlation in the PCeV. These findings partially support the hypothesis, which states that there is a correlation between mRNA expression and pericyte distribution in the zebrafish that mRNA expression is not the only factor responsible for pericyte recruitment to blood vessels.

# Sarah Neighbor, Saint Francis DeSales High SchoolPoster Presentation | 1:30 pm | Capital Center Field House

## The Characterization of MHC Class I and II Molecules Among Laboratory Ferrets: A Comprehensive In Silico Analysis

Ferrets accurately phenocopy many aspects of human disease that are absent in lower animal models, such as a full spectrum of lung transplant rejection pathology. Major Histocompatibility Complex (MHC) class I and class II molecules are crucial for immune recognition and are highly variable between individuals. Our ability to call variation among these MHC molecules depends on the resolution of Whole Genome Shotgun (WGS) sequencing, which allows for accurate identification of MHC variants based on genetic variability. In this study, we queried the genomic sequence of 11 individual ferrets using NCBI Basic Local Alignment Tool (BLAST) to identify a region of variation within archetypical MHC class I and class II genes. We designed Polymerase Chain Reaction (PCR) primers that would anneal to highly conserved genomic areas, flanking the selected variable region to amplify MHC alleles spanning multiple haplotypes. This research suggests that there is a critical need for an increase in the characterization of ferret MHC molecules.

#### Allison Payton, Zane Trace High School

Poster Presentation | 1:30 pm | Capital Center Field House

#### Water Bottle Heating

This project is based on what temperature will heating water bottles change the mineral content. This research is important to anyone who buys plastic water bottles. I hypothesized that the mineral content would change when it reached 158°F. I believe the mineral content will change because of an article about an experiment in 2014 that heated water bottles to 158°F for four weeks and discovered BPA and other chemicals in the water. To perform this experiment, I performed the pH meter test, and TDS meter test, and used water testing strips. I poured 100 ml of water into a cup. Then, I placed the pH meter into the water and stirred slowly. I got a stable reading in about two minutes. Then, I placed the TDS meter into the water and waited two seconds for the results. I gently shook off the water and compared the pad to the water chart. The results showed that the pH, hardness, sulfate, lead, zinc, fluoride, and alkalinity were all affected by increasing the temperature. After heating the bottles, lead was found in 19 of the 30 water bottles. Also, the sulfates, hardness, and zinc increased in the water which could cause diarrhea and dehydration. There was one bottle that increased in fluoride which can cause skeletal fluorosis. It can be concluded that it is unsafe to drink out of a plastic water bottle left in a car on a hot day.

#### Griffin Quigley, University School

Oral Presentation | 9:55 am | 103 Ruff Memorial Learning Center

#### The Turbine: A Combustionless Motor

Since the industrial revolution, pollution and waste have made a negative impact on our environment. One of the major contributors to this pollution is the internal combustion engine. So, the world needs a more efficient and environmentally friendly engine to replace internal combustion engines because current internal combustion engines are widespread, inefficient, and release lots of pollution. The is using the technology found in steam turbines to create a small-scale turbine which is powered by compressed air and has a much higher efficiency than internal combustion engines. The turbine is primarily made up of 3d printed parts as well some metal hardware which reinforces the plastic pieces. The collected data revealed that the turbine was less efficient than required to be better than an internal combustion engine. The inefficiency was most likely a result of air leaks around the rotors in the turbine. However, the collected data also revealed that the turbine performed better at lower pressures with less nozzles. This research demonstrates that it is possible to construct a turbine that works on compressed air, however it also demonstrates that the prototype must be improved before it can be effective and efficient.

# Manan Raina, Hawken SchoolOral Presentation | 10:20 am | 102 Ruff Memorial Learning CenterGlobal and National Burden of Type 2 Diabetes Mellitus Attributable to PM2.5 Air Pollution: An Analysis of the GBD Study from1990-2019

There is an established link between air pollution and chronic disease. In this study, we measure the impact and health burden of fine particulate matter (PM2.5) in chronic disease in the United States, specifically type 2 diabetes mellitus (T2DM), chronic obstructive pulmonary disease (COPD), ischemic heart disease (IHD), and stroke. Data on the global burden of chronic disease attributable to air pollution were obtained from Global Burden of Diseases (GBD) 2021. The number of deaths and disability-adjusted life-years (DALYs) attributable to air pollution from 1990 to 2021 were extracted and analyzed by different US locations and years. The death rates due to chronic diseases attributable to PM2.5 in the US has shown to be decreasing. In 2021, the death rates due to T2DM [1.307] was the lowest followed by stroke [2.004], COPD [2.119] and IHD [5.865]. In 2021, as compared to 1990, the death rate decreased by 36% for T2DM, 30% for COPD, 70% for IHD and 61% for stroke. In 2021, the DALY rate due to stroke [52.389] was lowest, followed by COPD [54.147], T2DM [73.32] and IHD [119.471]. In the USA in 2021, the DALY rate has decreased by 16.4% for T2DM, 39.6% for COPD, 70.3% for IHD and 58.9% for stroke, as compared to 1990. The results highlight a decreasing trend in death rates and DALYs and identify varying locations that remain at high risk of health burden from PM2.5 associated chronic disease. There is a continued need for addressing air pollution control and policy revisions targeted to patient subpopulations in the US where the burden PM2.5 can still be detrimental.

#### Manya Raina, Hathaway Brown School

Poster Presentation | 1:30 pm | Capital Center Field House

### Renal Reserve Evaluation in Children with Severe AKI and MODS Undergoing Kidney Replacement Therapy

Acute kidney injury (AKI) is a common and severe complication in critically ill pediatric patients, significantly impacting morbidity and mortality. Renal Functional Reserve (RFR) reflects the kidney's ability to increase glomerular filtration in response to physiological stress. The Furosemide Stress Test (FST) is used to evaluate RFR by assessing the kidney's diuretic response, potentially predicting AKI progression. We conducted a retrospective observational study including 83 critically ill children under 18 years of age who were diagnosed with AKI stage 3 and MODS at admission. Patients underwent the FST, which involved administering an intravenous dose of furosemide (1 mg/kg for furosemide-naïve patients and 1.5 mg/kg for those with prior exposure). Of the 83 children analyzed, 44 (53%) were FST-responsive. The FST-responsive group had significantly less shock (25.0% vs. 56.4%, p = 0.004) and disseminated intravascular coagulation (9.1% vs. 35.9%, p = 0.003). Both groups required mechanical ventilation at similar rates, but the duration was longer in the FST-responsive group (7 vs. 3 days, p = 0.001). The median ICU stay was also longer among FST-responsive patients (8 vs. 5 days, p = 0.004). Notably, FST-responsive patients had delayed initiation of continuous kidney replacement therapy (CKRT) and were more likely to receive intermittent rather than continuous dialysis. Mortality rates did not differ significantly. FST responsiveness is associated with fewer complications, a prolonged ICU stay, and a preference for intermittent over continuous dialysis, with a trend towards less mortality. FST non-responsive patients were critically ill.

#### Niklas Rietsch, University School

Oral Presentation | 10:45 am | 202 Ruff Memorial Learning Center

#### The Role of Primary Cilia in Parkinson's and Huntington's Disease

Neurological disorders such as Parkinson's disease (PD) and Huntington's disease (HD) affect millions globally and involve complex, multifaceted pathologies. PD is marked by dopaminergic neuron loss in the substantia nigra region, while HD is an autosomal dominant genetic disorder characterized by the toxic accumulation of mutant huntingtin protein. Emerging evidence highlights primary cilia as potential contributors to these diseases. Furthermore, there are many overlapping symptoms between ciliopathies, diseases caused by ciliary dysfunction, and PD as well as HD. This study leveraged publicly available microarray data to explore the differential expression of primary cilia genes in the substantia nigra region for PD and caudate nucleus for HD. DAVID gene ontology analysis was used to categorize genes and contextualize findings. Notably, this is the first study to investigate differential primary cilium gene expression in HD, finding some evidence for the presence of elongated cilia in remaining caudate nucleus cells. In PD, the significant upregulation of ciliary basal body protein, FBF1, and related genes correlates with a recently identified stress-induced cilium-to-nucleus pathway for senescence onset. This forwards the primary cilium as a potentially key regulator in senescent pathology in PD. Ultimately, this study's findings indicate that primary cilia dysfunction may exacerbate neurodegenerative pathology, acting as a locus of injury in PD and a contributor to HD progression. The future steps for this study include single-cell RNA sequencing to delineate cell-specific roles, followed by in vitro testing of candidate genes in neuronal cells, using senescence markers and ciliary morphology as key outputs.

#### Sonia Robinson, Hathaway Brown School

#### Poster Presentation | 1:30 pm | Capital Center Field House

# Quantum Information Science meets Mixed-Reality Technology through QuRIE (Quantum Realm for Immersive Education)

The Quantum Realm for Immersive Education (QuRIE) is a mixed-reality software that allows for digital interaction with the surrounding environment with 3D models of different Quantum Physics topics and basics. Using Microsoft Hololens, inherently 3D models such as Skyrmions can be shown in a simple way while still maintaining the Skyrmion shape and accuracy in 3D space. Skyrmions are characterized by a Unit Sphere, and when values such as vorticity or magnetization are changed, the Skyrmion will reflect those changes in its topological shape and formation. The ability to interact with these values and see the model change will allow for a comprehensive view of Skyrmions in their different forms, especially how they are affected by different planes of magnetization. The Hololens will be used to assist in visualizing 3D microscopic quantum objects such as magnetic Skyrmions. The Skyrmion has two forms, and the goal in the future is to connect them via an animation to view how the Skyrmion gradually unfolds from the 3D hedgehog spin texture to a two-dimensional magnetic structure. The visualization of the Skyrmion will aid in teaching an in-depth understanding of Skyrmionic properties.

#### Kenley Routt, Hilltop High School

Oral Presentation | 10:45 am | 102 Ruff Memorial Learning Center

#### The Effects of Sound on Sleep

The goal for this project was to find which sound promotes a deeper REM sleep. Many students struggle falling asleep at night, whether it occurs from stress due to academics or extracurricular activities. If a student is having a limited time in REM sleep it can affect their concentration in school and how their brain will process new information. Listening to a certain sound before an individual goes to sleep can help slow down their brain activity, which will prepare them to relax for bed. The hypothesis of this experiment was that the individuals who listened to white noise before they went to sleep would experience an increase in time of REM sleep when compared to those who listened to pink noise, brown noise, or no noise. Six participants listened to a cycle of three sounds before they went to sleep. The sounds were white noise, pink noise, brown noise, and no noise for the control group. The participants downloaded an app called Shut Eye, which tracked their sleep cycle by showing how much time they spent awake, in REM sleep, in light sleep, and in deep sleep. The days that the subjects listened to the noise was randomly sorted, so that they were not all listening to the same noise on the same nights. Each participant listened to each noise for two nights and sent their data to the researcher. After each night the participants were sent a survey about whether or not they thought the sound improved the quality of their sleep. The hypothesis was not statistically supported by this experiment. The average amount of time spent in REM sleep with white noise was 8%, compared to pink noise and brown noise which averaged 6%, and the control group which averaged only 5%. Although there was only a small numerical difference spent in REM sleep, subjects self-reported that they fell asleep faster in white noise compared to the other trials.

#### Vaibhav Sampath, William Mason High SchoolOral Presentation | 10:20 am | 103 Ruff Memorial Learning Center

#### Polynomial Regression Machine Learning to Predict Stress-Strain Curves

Materials and composites react in different ways depending on the stresses and strains they undergo. Experiments that allow us to evaluate the stresses and strains of these materials are often inefficient and time-consuming. The purpose of my study is to evaluate the effectiveness of machine learning models, specifically polynomial regression, as an approach to predicting non-linear stress-strain curves. If the findings positively support the effectiveness of polynomial regression, its implementation will significantly aid in the time-consuming process of running experiments, and it can be useful for numerous engineering applications, including the selection of materials. In this study, the polynomial regression model was trained on experimental data which recorded strain, load, and displacement measurements. Material properties like Young's modulus, yield stress, yield strain, and chord modulus were calculated from these measurements. These properties were used as input values to train the regression model. 27 sample datasets (from lab experiments run at the Materials, Mechanics, and Manufacturing lab at Ohio State University) were divided into training/testing sets, with 80% of the data used for training the model, and 20% for evaluating the performance and accuracy of the model. The results from this study show that polynomial regression can be used to predict stress-strain curves and could serve as an alternate approach to running time-consuming tensile or compression tests.

# Anshul Sharma, University School Oral Presentation | 11:35 am | 201 Ruff Memorial Learning Center A Novel Analysis on the Effects of Changes in the Social Vulnerability Index and its Subcategories on Changes in Survival Rates for Six Common Cancers from 2000-2020

The CDC's Social Vulnerability Index (SVI) measures an individual's health vulnerability based on geographic location and environment, containing four subcategories: socioeconomic status, household characteristics, housing type, and racial and ethnic minority. Previous studies established correlations between static SVI values and cancer survival rates. This study explores the effect of changes in county-level SVI values from 2000 to 2020 on changes in three-year survival rates for six common cancers: breast, cervical, colorectal, lung, melanoma, and prostate. SVI data and Surveillance, Epidemiology and End Results (SEER) survival rate datasets were run through rigorous exclusion criteria and categorized based on degree of change. Multinomial logistic regressions in R were employed to examine correlations and statistical significance between the overall and subcategory SVI and survival rates for vulnerable minority populations in breast and prostate cancers, partially disproving the original hypothesis. Findings also reveal the varying influence between different SVI factors across cancers, possibly aiding in creating tailored policy interventions that can jointly address multifaceted health vulnerabilities in the future. Further research is needed to expand these findings across additional contexts and populations.

# CapitalUniversity

#### Gavin Sheppard, University School

#### Oral Presentation | 11:35 am | 102 Ruff Memorial Learning Center

#### Predicting Player Performance in Major League Baseball

The primary objective of this research project was to develop a predictive model for estimating a pitcher's Wins Above Replacement (WAR) for a given year based on historical pitching data. This model assists in making informed decisions on player development, scouting, and team strategy, offering insights on how a player's statistics translate to their value on the field. The dataset comprised historical MLB pitching statistics from 2018-2023, encompassing metrics such as ERA, WHIP, K/9, and HR/9, gathered from Fangraphs and preprocessed to account for inconsistencies, such as the shortened 2020 season. Key data preparation steps included organizing rows with 16 unique features over two years, totaling 32 features per prediction. To enhance accuracy, various machine learning models, including LASSO regression, were tested to identify those most predictive of WAR. LASSO regression proved effective in feature selection, enabling a more streamlined model and yielding a mean squared error of 0.66 and an R-squared value of 0.45. By examining patterns between player stats and WAR, this model can be extended to predict future player value and explore new metrics for evaluating players. This approach paves the way for more comprehensive applications in sports analytics, potentially aiding teams in optimizing rosters, scouting, and player development based on predictive analytics. This model not only offers valuable insights for player evaluation and team strategy but also serves as a foundation for further development of predictive analytics in sports, enabling teams to optimize their rosters and make data-driven decisions.

#### Miracle N. Smith, Hathaway Brown School

Poster Presentation | 1:30 pm | Capital Center Field House

#### School Curriculum, Policies, and Culture Around Climate Change

The study aims to examine if variation exists across Northeast Ohio schools' climate literacy, and if racial and social demographics as well as in how curriculum, policies, and school culture around climate change may correlate and how that might facilitate different levels of climate literacy. This research will draw upon survey and interview data to investigate these metrics and to what extent schools that vary in their racial and social demographics also vary in terms of their policies and curriculum that revolve around climate literacy.

# Nandita Srikumar, Solon High School Oral Presentation | 11:10 am | 202 Ruff Memorial Learning Center EGCG: A Novel Therapeutic, Natural Product Inhibiting CDK5-Mediated Phosphorylation of CRMP-2 and Tau in Alzheimer's Disease

Alzheimer's disease is a neurodegenerative disorder characterized by the hyperphosphorylation of Tau and collapsin response mediator protein (CRMP-2), a newly identified protein in the Alzheimer's signaling pathway. Hyperphosphorylation of these proteins is caused by deregulated cyclin-dependent kinase-5 (CDK5) protein function. This increased phosphorylation activity leads to neurofibrillary tangles (NFTs), composed of hyperphosphorylated Tau and CRMP-2, leading to a loss in neuronal synaptic communication. Thus, all three proteins are potential targets to alleviate the impacts of Alzheimer's. There is a lack of consensus on the pathological basis of Alzheimer's leading to inadequate treatment. Thus, this paper explores the molecular interactions of proteins involved in Alzehimer's and epigallocatechin-3 gallate (EGCG), a medicinal herb with promising results. EGCG, a catechin found in green tea, has neuroprotective properties against inflammation of neural tissue. To examine EGCG's effects on key Alzheimer's proteins, binding affinities between CRMP-2, CDK5, and Tau, were characterized in the presence or absence of EGCG, using microscale thermophoresis (MST). The results indicate that EGCG decreased the binding affinities between the proteins. Kinase assays were conducted to uncover the impact on CDK5's phosphorylation, revealing that the addition of CRMP-2 or Tau to CDK5 increased CDK5's phosphorylation of EGCG to the CRMP-2-CDK5 mixture and EGCG to the Tau-CDK5 mixture moderately decreased CDK5's activity. Additionally, computational studies were conducted to determine binding sites and corroborate the binding results. These results suggest that larger concentrations of EGCG could inhibit phosphorylation by CDK5, thereby reducing hyperphosphorylation of Tau and CRMP-2.

#### Emily Stringer, Hathaway Brown School

Poster Presentation | 1:30 pm | Capital Center Field House

#### What is the Effect of Decriminalized and Legalized Marijuana on Fatal Car Accidents?

Officially marijuana is recognized as a Schedule One illicit drug in the United States. Despite its national qualification marijuana use laws are decided by states. States have either chosen to keep marijuana fully illegal, decriminalize the use of certain amounts of marijuana, allow the medical use of marijuana, decriminalize and allow medical use of marijuana, or allow the recreational use of marijuana. With each state allowed to make its own decision, it is imperative that the effects, both positive and negative, are understood by lawmakers and the public alike. The goal of this paper is to better understand how decriminalization or legalization laws impact car safety. Using correlation analysis, including summary statistics, graphs, t-tests, and correlation matrices, we seek to understand the impacts of marijuana laws on fatal car accidents. Our analysis revealed a negative correlation between marijuana use, our variable of interest, and fatal car accidents, our dependent variable. Moreover, data showed that after law changes fatal car accidents trended down. To control for car safety and environmental changes we ran t-tests and summary statistics taking years into account. Our results show a correlative result, but do not prove causation.

#### Irene Sun, Ottawa Hills High School

#### Oral Presentation | 9:55 am | 07 Ruff Memorial Learning Center

#### Ultrasonic Degradation of Five Toxic Microcystin Congeners for Clean Water

Dangerous cyanobacterial harmful algal blooms (CyanoHABs) occur when cyanobacteria grow uncontrollably in warm, nutrient-rich waters, releasing toxins such as microcystins, which threaten human and ecological health. Of all microcystin congeners, MC-LR, MC-RR, MC-YR, MC-LA, and MC-LF are among the most widespread and toxic. Ultrasonic probe technology has emerged as a promising method for microcystin degradation due to its high efficiency, low maintenance, and environmentally friendly nature. However, most ultrasonic treatment research has focused on MC-LR, leaving a significant knowledge gap regarding other congeners. This study evaluated the degradation of five congeners in two experiments using ½" and ½" probes. Samples were taken at specific time intervals and analyzed via ultra-high-performance liquid chromatography and mass spectrometry (UHPLC-MS) to quantify residual microcystins. Across both experiments, MC-LF was the most degraded congener, followed by MC-LA, MC-LR, MC-YR, and MC-RR. MC-LF's enhanced degradation is likely due to its phenyl ring with additional unsaturations, which are particularly susceptible to hydroxyl radical attack. Hydrophobic congeners were also more effectively degraded due to their tendency to concentrate near ultrasonic cavitations. These findings expand understanding of ultrasonic degradation across multiple congeners and emphasize its potential for improving water treatment strategies, which is imperative to protect human health.

# Maya Tang, Hathaway Brown SchoolOral Presentation | 11:35 am | 07 Ruff Memorial Learning Center

# Aggregation and Cellular Localization Properties of Human and Murine M Cone Opsin

We examined the aggregation and cellular localization of wild type (WT) and mutant M cone opsin (MOP) in vitro and the impact of the C198R murine MOP mutation on M cones, S cones, and rods in vivo. Aggregation properties of WT human (hMOP) and murine (mMOP), human C203R MOP, murine C198R MOP, and a chimeric mouse/human MOP were determined by Förster resonance energy transfer (FRET). Cellular localization was determined by immunohistochemistry. Retinal cryosections from wild type B6 mice and Opn1mwC198R knockin mice were compared. hMOP exists as a mixture of oligomers and aggregates; mMOP predominantly forms aggregates. C203R and C198R mutants misfold and aggregate. hMOP trafficked properly to the plasma membrane (PM); mMOP and both mutants trafficked to the endoplasmic reticulum. Treatment with 9-cis retinal allowed mMOP, but not C198R MOP, to traffic to the PM. A chimeric mouse-human MOP aids oligomerization. In Opn1mwC198R mice, MOP expression is absent by 2 weeks of age. C198R MOP does not affect the expression of rhodopsin or S opsin. Opn1mwC198R mice show a significant reduction of cones compared to control mice by 2 months of age. WT human MOP is more stable than WT murine MOP. Treatment of WT murine MOP with 9-cis retinal improves folding and cellular trafficking to the PM. The mouse/human chimeric MOP has improved folding and oligomerization to a small extent. In vivo, the C198R mutation has a significant impact on MOP expression and cone cell degeneration from an early age.

# Elainie C. Theodorou, Hathaway Brown SchoolOral Presentation | 11:10 am | 201 Ruff Memorial Learning Center

#### Association between Trigeminal Neuralgia and Degenerative Cervical Myelopathy: A Cross-Sectional Study using U.S. Data

Trigeminal neuralgia (TN) is an idiopathic pain disorder, classified by paroxysmal pain in the face. The spinal trigeminal tract extends into the spinal cord as far as the fourth cervical vertebrae, and limited research suggests that cervical spine compression may be a risk factor for TN. We hypothesized that adults with TN would have a greater likelihood of concurrent degenerative cervical myelopathy (DCM) compared to matched adults without TN. The data used in this study spanned the past 20 years and were obtained from TriNetX, a national database with de-identified medical records from 113 million patients across 79 million healthcare institutions. Two groups of adults ( $\geq$  18 years of age) were created: patients with (1) TN and (2) No-TN excluding predisposing conditions for TN (e.g., multiple sclerosis, ophthalmic and oral/maxillofacial surgery), then groups were propensity matched (e.g., age, sex, body mass index, diabetes mellitus, hypertensive diseases, migraine, osteoporosis) to minimize between group differences. After matching, both groups consisted of 37,163 patients and the mean point prevalence was 0.55% in the TN group (95% CI: 0.47–0.63%) and 0.04% (95% CI: 0.03–0.06%) in the No-TN group, resulting in an odds ratio of 12.94 (95% CI: 7.78–21.53; p < 0.0001). The present data show that adults with DCM are over 12 times as likely to have concurrent TN. These findings support our hypothesis and suggest that DCM may be a risk factor for TN.

#### Lina Tian, Hathaway Brown School

#### Oral Presentation | 11:10 am | 07 Ruff Memorial Learning Center

#### Characterization of Blood Vessel Formation After the KO of VPS35 in Astrocytes in the Developing Mouse Brain

The blood-brain barrier (BBB) is a highly selective and semipermeable barrier, essential to the neurovascular system, that allows only specific molecules and ions to pass through. Astrocytes are the most abundant glial cells in the brain and play a crucial role in maintaining BBB function by supporting blood vessels. Dysregulation of astrocytes has been linked to BBB damage and neurodegenerative diseases, such as Alzheimer's disease (AD). Vascular Protein Sorting 35 (VPS35) is a key component of the retromer complex which aids in transmembrane protein transportation. While VPS35's role in neurons is well-studied, its function in astrocytes remains unclear. In this study, we provide evidence of blood vessel malformation and underdevelopment under VPS35 knockout conditions. VPS35 was knocked out in mice through tamoxifen injection at the P6 stage, a critical period for angiogenesis. Immunostaining with CD31 and PODX, as well as laser Doppler imaging, revealed a significant decrease in blood vessel density, length, diameter, branching, and perfusion in VPS35 knockout mice. These findings support the hypothesis that VPS35 is vital for astrocytic function related to the BBB. Fragmented and underdeveloped blood vessels observed in the knockout mice suggest neuroinflammation and oxidative stress, contributing to Aß plaque accumulation and hypoxia. Our findings demonstrate how critical astrocytic VPS35 is for proper BBB function and shows its potential role in AD pathology. Further research is needed to uncover the underlying mechanisms by which VPS35 influences BBB function, particularly the HIF1 $\alpha$ -VEGFa signaling pathway.

#### Adonis Wazni, University School

Oral Presentation | 10:45 am | 103 Ruff Memorial Learning Center

#### Biomimicry in Ship Hulls to Reduce Noise Pollution and Harmful Wakes

Noise pollution and ship-induced wakes not only harm wildlife and erode shores, but also cost the growing shipping industry billions of dollars in refloating beached crafts. Aquatic insects and penguins travel swiftly through the water, using irregular surface texture to create a bubble barrier around them. Similarly, in sports, golf balls' dimples create turbulence to ensure smoother flight, while swimsuits developed by Nike use texture to slip through the water with less resistance. This project compared performance through a canal of a control model ship hull and designs implementing microscopic and macroscopic texture created by hydrophobic spray and 6mm-radius hemispheres on the hull's surface. Models were each driven by a 3-speed electric motor. Testing a total of four designs, modified models were found to have significantly reduced wake height, as well as maintain a straighter path and reach higher speeds, especially at higher motor settings. The joining of design elements yielded the best results. The final model combining micro and macroscopic texture with the hydrophobic spray and hemispheres used together provided a 72.5% reduction in wake height and a 7.6% increase in speed compared to the control for motor setting 3. None of the designs provided significant reductions to underwater noise, though at higher speeds all created either equal to or less noise than the control. This project supports the application of biomimetic designs to reduce ecological disruptions and improve stability and efficiency in watercraft.

#### Sophia K. Wu, Columbus Academy

Oral Presentation | 10:45 am | 07 Ruff Memorial Learning Center

#### Proteomics Analysis of Proteins Regulated by H2AX in Glioma Stem Cells

Glioblastoma stem cells (GSCs) play a crucial role in therapy resistance and tumor recurrence due to their enhanced tumorigenic potential, selfrenewal capabilities, and ability to differentiate into heterogeneous glioma cells. The plasticity of glioma cells allows for the conversion of differentiated glioma cells (DGCs) back into GSCs, contributing to tumor regrowth post-therapy. Chromatin structure and histone modifications are fundamental in regulating gene expression and maintaining the stemness of GSCs. In this study, we revealed an elevated level of histone H2AX, a variant of histone H2A, in GSCs compared to their corresponding DGCs. In vitro and in vivo studies demonstrated that H2AX is essential for tumor initiation. Proteomic profiling of H2AX knockout (KO) vs wild-type (WT) GSCs (GBM387 cells) revealed that H2AX regulates the expression of multiple proteins associated with stemness. Notably, H2AX KO significantly increased histone H3 lysine 79 methylation (H3K79me), which has been reported to be involved in the regulation of stemness-associated gene expression, suggesting a potential mechanism by which H2AX regulates gene expression. In conclusion, our findings provide new insights into the molecular mechanisms driving GSC plasticity and identify potential therapeutic targets to improve outcomes for patients with glioblastoma.

#### Koyuki Yagi, Columbus School for Girls

Oral Presentation | 11:10 am | 103 Ruff Memorial Learning Center

#### Evaluating the Effects of Laser Power and Travel Speed on Weld Penetration and Microstructure of Type 304L Stainless Steel

Compared to arc welding processes such as gas metal arc welding, which can produce significant heat and spatter, laser welding offers low heat input and high quality, precise welds. The objective of this research was to correlate laser power and travel speed to weld penetration and microstructure of type 304L stainless steel. In this study, 3/16<sup>th</sup> inch 304L stainless steel coupons were welded using an IPG Photonics YLS-6000-S4T fiber laser (1070 nm). The laser parameters of this study included 1200-5200W power, 25-100 mm/s travel speed, top-hat distribution, and 604µm spot size. The laser welds were cut through their steady state regions, mounted, ground, polished, and chemically etched to observe their cross sections. From these cross sections, weld penetration was measured, and solidification mode was determined from microstructure. By plotting measured weld penetration against laser power at three travel speeds, it was found that decreasing travel speed and increasing laser power increased power per unit length and weld penetration. From a predictive microstructural map and observed skeletal ferrite with no evident solidification cracking in the microstructure, FA solidification was found for this laser parameter set on type 304L stainless steel.

# CapitalUniversity

#### Alex Zhang, Centerville High School

#### Oral Presentation | 11:10 am | 102 Ruff Memorial Learning Center

#### A Novel Nonmetallic and Biodegradable Hydrogel Treatment for Brain Aneurysms

Brain aneurysms are blood vessels in the brain that bulge or balloon, leading to a 50% mortality rate. Common treatment methods, particularly endovascular coiling, do not biodegrade and result in 30% or higher of patients experiencing unfavorable outcomes, such as edema and hydrocephalus, due to elevated levels of metals in the brain. Polymer-based treatments are more efficient and less harmful than metallic-based treatments. As such, I designed a porous scaffold that promotes vascular remodeling and endothelialization with biodegradation triggered by patient-specific enzymatic activity that can be precisely injected into the aneurysm through a transition of liquid-like to solid-like characteristics, remain stable in the aneurysm conditions, and adhere to endothelial cells. My treatment is a copolymer of Pluronic F-127 and F127-dimethacrylate, crosslinked with an ammonium persulfate, FeCl 3, and L-ascorbic acid crosslinker/catalyst. The results revealed that the gel chemically crosslinks in 300 seconds for injection, retains its solid-like characteristics while under carotid-artery-like shear stress and blood flow conditions, and allows cell adhesion for endothelialization. However, further testing must be performed to ensure the functionality of all the proposed abilities. This project takes a monumental step toward the paradigm shift of polymer-based treatments for cerebral aneurysms and other vascular diseases.

# Elena Zhu, Upper Arlington High SchoolOral Presentation | 10:20 am | 07 Ruff Memorial Learning CenterA Computer-Generated Analysis of Live Cancer Cell Calcium Flux Oscillation

Liposarcoma is a rare form of soft tissue cancer that originates from fat cells. For more than three decades, there have been no updates to treat this deadly disease due to limited understanding of its biology. Recently, my advisor, Dr. Joal Beane's laboratory demonstrated that the IWS1 gene is aberrantly elevated in patients with Liposarcoma and higher IWS1 levels are correlated with poorer patient survival. However, the molecular mechanisms underlying IWS1 mediated regulation of Liposarcoma remain unknown. In this study, we investigate the preexisting correlation between intracellular calcium and IWS1 level. Scientists have shown that higher levels of intracellular calcium yielded more tumor metastasis in other tumor types. Thus, we devised an experiment to test IWS1 and its effect on Calcium fluctuations in Liposarcoma tumors. After performing a Calcium Flux on both a Parental Liposarcoma cell line and cells treated with a CRISPR-Cas 9 gene editing system to knockout the IWS1 gene (IWS1-/-). It was determined that parental Liposarcoma cells have robust intracellular calcium oscillations that were significantly larger than IWS1-/- counterparts. Taken together, our findings suggest that IWS1 might regulate liposarcoma aggressiveness by controlling intracellular calcium oscillation. The IWS1 gene may be the key to future targeted Liposarcoma treatments.

#### Michael Zhu, University School

Oral Presentation | 11:35 am | 103 Ruff Memorial Learning Center

# Novel Flexible Substrate-Based 2D MoS2 Devices and Novel Ionic Liquid Gated MoS2 Field-Effect Transistors on Flexible Substrates

Flexible two-dimensional (2D) field-effect transistors (FETs) have gathered great interest, due to the need to solve scalability problems that are commonplace in 3D FETs. Specifically, the replacement of rigid substrates with flexible materials, along with the usage of transition metal dichalcogenides (TMDCs) with strain-resistant and excellent electrical characteristics has led to an interest in developing 2D FETs using elastomer and polymer-based materials such as polydimethylsiloxane (PDMS) and polyethylene terephthalate (PET). Herein, we demonstrate the feasibility of using PDMS as a substrate for multilayer MoS2-based devices, using polymers polypropylene carbonate (PPC) and poly(methyl methacrylate) (PMMA) as means of facilitating transfer of mechanically exfoliated MoS2, obtaining high output current (maximum ~ -0.65-0.55 µA µm-1), ohmic behavior, and low contact resistivity. Further, we demonstrate the ability for polymer PET to be used as a flexible substrate for multilayer MoS2-based FETs, with devices exhibiting transfer characteristics comparable to rigid MoS2 FETs in literature, showing acceptable field effect mobility (1.53-14.39 cm2 V-1 S-1), good on-off ratios (maximum ~1 X 105), and acceptable subthreshold slope (minimum average 371.48 mV dec-1), via using novel ionic liquid N,N-diethyl-N-(2-methoxyethyl)ammonium bis(trifluoromethane-sulfonyl)imide ([DEME][TFSI]) through ionic liquid gating (ILG). The work presented here is one of the first in demonstrating the feasibility of ILG on PET substrate-based FETs, demonstrates the alternative usage of PDMS as a substrate in 2D devices, and provides a platform for the incorporation of ILG as a means of gating in flexible 2D FETs in the future.

# **Oral Judging Rubric (2025)**

Rubric ranges are shown for 5 points possible. Multiply by 2 or 3 if points possible are 10 or 15. Total points possible equal 100. The decisions of the judging team are final.

Criteria	Excellent	Satisfactory	Needs Improvement	Points
Identification of Research Problem	<ul> <li>The presenter clearly demonstrates a thorough understanding of existing knowledge about the research problem.</li> <li>The research problem is clearly stated and explained in detail.</li> </ul>	<ul> <li>The presenter demonstrates some existing knowledge about the research problem.</li> <li>The problem is stated but lacks detailed explanation.</li> </ul>	<ul> <li>The presenter demonstrates little existing knowledge about the research problem.</li> <li>Statement of the problem us unclear and explanation is sparse.</li> </ul>	5
Scientific Thought	<ul> <li>There is balanced presentation of relevant and legitimate information and data to support the research problem.</li> <li>The presenter shows thoughtful, in- depth analysis of the topic.</li> </ul>	<ul> <li>The information presented supports a central purpose or argument at times.</li> <li>Analysis of the topic is basic or general.</li> </ul>	<ul> <li>The central purpose is not clearly defined.</li> <li>Analysis is vague or not evident.</li> </ul>	5
Creativity/Originality	<ul> <li>The presenter fully demonstrates their individual contributions to the project.</li> </ul>	The presenter only partially demonstrates their individual contributions to the project.	<ul> <li>The presenter does not acknowledge their individual contributions to the project.</li> </ul>	5
Acknowledgements	<ul> <li>Acknowledges major assistance received and credits anyone who helped with the project and describes in detail how they helped.</li> </ul>	<ul> <li>Acknowledges major assistance received and credits anyone who helped with the project.</li> </ul>	<ul> <li>Does not acknowledge major assistance received or credit those who helped.</li> </ul>	5
Research Design	<ul> <li>Science:</li> <li>Description of research design and procedures is detailed and shows reproducibility.</li> <li>Control and variables are clearly identified and explained.</li> <li>Engineering, computer science, technology:</li> <li>Clear, detailed description and recognition of relationship between design and end product.</li> <li>Addresses economic feasibility of solution.</li> <li>Solution is tested for performance under conditions of use.</li> </ul>	<ul> <li>Science:</li> <li>Description of research design and procedures lacks some detail but shows reproducibility.</li> <li>Control and variables are identified but may not be thoroughly explained.</li> <li>Engineering, computer science, technology:</li> <li>Description and recognition of relationship between design and end product.</li> <li>Partially addresses economic feasibility of solution.</li> <li>Solution is tested for performance under conditions of use.</li> </ul>	<ul> <li>Science:         <ul> <li>Description of research design and procedures lacks detail and does not show reproducibility.</li> <li>Control and variables are poorly identified.</li> </ul> </li> <li>Engineering, computer science, technology:         <ul> <li>Very little description and recognition of relationship between design and end product.</li> <li>Does not address economic feasibility of solution.</li> <li>Solution is not tested for performance under conditions of use.</li> </ul> </li> </ul>	15
Methods	<ul> <li>Encompasses all materials required.</li> <li>Clearly states the hypothesis/research questions and explains the study design.</li> <li>If used, statistical procedures are included.</li> <li>A detailed narration of the steps taken to complete the experiment is included.</li> </ul>	<ul> <li>Encompasses most materials required.</li> <li>States the hypothesis/research questions and explains the study design.</li> <li>The statistical procedures are included but are unclear.</li> <li>A narration of the steps taken to complete the experiment is included but may lack detail.</li> </ul>	<ul> <li>Does not encompass all materials required for the research.</li> <li>Hypothesis/research questions are not stated.</li> <li>The statistical procedures are not included.</li> <li>Steps taken to complete the experiment are listed but are unclear.</li> </ul>	15
Results	<ul> <li>Results of the research are summarized.</li> <li>Data trends are clearly addressed and analyzed.</li> <li>Data that can stand alone in tables/figures are included in the paper or appendix.</li> </ul>	<ul> <li>Results of the research are partially summarized.</li> <li>Identification and analysis of data trends is vague.</li> <li>Data that can stand alone in the form of tables/figures are sometimes included.</li> </ul>	<ul> <li>Results of the research are poorly summarized.</li> <li>Data trends are not addressed.</li> <li>Data is not appropriately represented in tables/figures.</li> </ul>	15

Criteria	Excellent 4-5	Satisfactory 2-3	Needs Improvement 0-1	Points Possible
Discussion & Conclusions	<ul> <li>Conclusion is logical and relevant to the research problem and results of experimentation or testing.</li> <li>Discussion addresses the significance of the results in detail, as well as recognizes the limits of the research.</li> <li>Practical and/or theoretical implications of the research are recognized.</li> </ul>	<ul> <li>Conclusion may rely on unsound reasoning and does not fully address its relevance.</li> <li>Discussion addresses the significance of results but lacks detail and/or only partially addresses the limits of the research.</li> <li>Practical and/or theoretical implications of the research are recognized.</li> </ul>	<ul> <li>Conclusions are not based on results and/or do not tie into the research problem or the relevance of results.</li> <li>The significance of the results is barely discussed, and the limits of the research are not addressed.</li> <li>Discussion does not recognize the practical and/or theoretical implications of the project.</li> </ul>	15
References	<ul> <li>References listed in the bibliography are significant, published, and relevant sources.</li> </ul>	<ul> <li>References listed in the bibliography are somewhat significant, published, and relevant sources.</li> </ul>	<ul> <li>References listed are irrelevant, insignificant, or unpublished.</li> </ul>	5
Communication	<ul> <li>Student is able to clearly communicate research results to non-specialized audience members and judges.</li> <li>Student defines terms as needed and avoids overuse of technical jargon.</li> <li>Responses to questions from judges and audience are thoughtful and appropriate.</li> </ul>	<ul> <li>Student is able to communicate research results to judges but may not be able to reach non-specialized audience members.</li> <li>Student defines terms sometimes but uses technical jargon.</li> <li>Responses to questions from judges and audience are thoughtful and appropriate.</li> </ul>	<ul> <li>Student is not able to communicate research results clearly.</li> <li>Student is not able to avoid jargon or define terms used.</li> <li>Student struggles to answer questions from judges and audience members.</li> </ul>	15
TOTAL POINTS				100

# Poster Judging Rubric (2025)

Rubric ranges are shown for 5 points possible. Multiply by 2, 3, or 4 if points possible are 10, 15, or 20. Total points possible equal 100. The decisions of the judging team are final.

Criteria Excellent Satisfactory **Needs Improvement** Points 4-5 2-3 Possible 0 - 115 All posters must include: Poster includes all required Poster includes around half of Poster includes few or none of Title elements the required elements. the required elements. Hypothesis or **Engineering Design** Methods and Procedures Data Analysis Results/Conclusion **Bibliography/References** Acknowledgements (may be included, not required) **Visual Presentation** Overall visually appealing; not Visual appeal is adequate; Not very visually appealing; 15 cluttered; colors and patterns somewhat cluttered; colors and cluttered; colors and patterns enhance readability patterns detract from readability. hinder readability. Uses font sizes/variations which Use of font sizes/variations to Use of font sizes/variations to • facilitate the organization, facilitate the organization, facilitate the organization, presentation, and readability of presentation, and readability of presentation, and readability of the research. the research is somewhat the research is Graphics (e.g., tables, figures, inconsistent/distracting. inconsistent/distracting. Graphics (e.g., tables, figures, Graphics (e.g., tables, figures, etc.) are engaging and enhance . etc.) adequately enhance the the text. etc.) do not enhance the text. Content is clearly arranged so text. Content arrangement is that the viewer can understand ٠ Content arrangement is somewhat confusing and does order without narration. not adequately assist the viewer somewhat confusing and does not adequately assist the viewer in understanding order without in understanding order without narration. narration. **Statement of Research** • The presenter clearly The presenter demonstrates • The presenter demonstrates little 5 some existing knowledge about Problem demonstrates a thorough existing knowledge about the understanding of existing the research problem. research problem. knowledge about the research The problem is stated but lacks • Statement of the problem is problem. detailed explanation. unclear and explanation is sparse. The research problem is clearly stated and explained in detail. Scientific Thought, The presenter fully demonstrates The presenter only partially • The presenter does not 5 Creativity, Originality their individual contributions to demonstrates their individual acknowledge their individual the project. contributions to the project. contributions to the project. There is balanced presentation of • The information presented The central purpose is not clearly • relevant and legitimate supports a central purpose or defined. information and data to support argument at times. Analysis is vague or not evident. the research problem. Analysis of the topic is basic or The presenter shows thoughtful, general. in-depth analysis of the topic. Methods **Encompasses all materials** Encompasses all materials Does not encompass all materials 10 required, states the required, states the hypothesis required for the research and hypothesis/research questions /research questions and explains hypothesis/research questions and explains the study design. the study design. are not stated. If used, statistical procedures are The statistical procedures are The statistical procedures are not included. included but are unclear. included. A narration of the steps taken to A narration of the steps taken to Steps taken to complete the complete the experiment is complete the experiment is experiment are listed. included. included.

Criteria	Excellent	Satisfactory	Needs Improvement	Points
	4-5	2-3	0-1	Possible
Research Design	<ul> <li>Science:</li> <li>Description of research design and procedures is detailed and shows reproducibility.</li> <li>Control and variables are clearly identified and explained.</li> <li>Engineering, computer science, technology:</li> <li>Clear, detailed description and recognition of relationship between design and end product.</li> <li>Addresses economic feasibility of solution.</li> <li>Solution is tested for performance under conditions of use.</li> </ul>	<ul> <li>Science:</li> <li>Description of research design and procedures lacks some detail but shows reproducibility.</li> <li>Control and variables are identified but may not be thoroughly explained.</li> <li>Engineering, computer science, technology:</li> <li>Description and recognition of relationship between design and end product.</li> <li>Partially addresses economic feasibility of solution.</li> <li>Solution is tested for performance under conditions of</li> </ul>	<ul> <li>Science:</li> <li>Description of research design and procedures lacks detail and does not show reproducibility.</li> <li>Control and variables are poorly identified.</li> <li>Engineering, computer science, technology:</li> <li>Very little description and recognition of relationship between design and end product.</li> <li>Does not address economic feasibility of solution.</li> <li>Solution is not tested for performance under conditions of use.</li> </ul>	10
Results	<ul> <li>Results of the research are summarized.</li> <li>Data trends are clearly addressed and analyzed.</li> <li>Data that can stand alone in tables/figures are included in the paper or appendix.</li> </ul>	<ul> <li>use.</li> <li>Results of the research are partially summarized.</li> <li>Identification and analysis of data trends is vague.</li> <li>Data that can stand alone in the form of tables/figures are sometimes included.</li> </ul>	<ul> <li>Results of the research are poorly summarized.</li> <li>Data trends are not addressed.</li> <li>Data is not appropriately represented in tables/figures.</li> </ul>	10
Discussion & Conclusions	<ul> <li>Conclusion is logical and relevant to the research problem and results of experimentation or testing.</li> <li>Discussion addresses the significance of the results in detail, as well as recognizes the limits of the research.</li> <li>Practical and/or theoretical implications of the research are recognized.</li> </ul>	<ul> <li>Conclusion may rely on unsound reasoning and does not fully address its relevance.</li> <li>Discussion addresses the significance of results but lacks detail and/or only partially addresses the limits of the research.</li> <li>Practical and/or theoretical implications of the research are recognized.</li> </ul>	<ul> <li>Conclusions are not based on results and/or do not tie into the research problem or the relevance of results.</li> <li>The significance of the results is barely discussed, and the limits of the research are not addressed.</li> <li>Discussion does not recognize the practical and/or theoretical implications of the project.</li> </ul>	15
Communication	<ul> <li>Student is able to clearly communicate research results to non-specialized audience members and judges.</li> <li>Student defines terms as needed and avoids overuse of technical jargon.</li> <li>Responses to questions from judges and audience are thoughtful and appropriate.</li> </ul>	<ul> <li>Student is able to communicate research results to judges but may not be able to reach non-specialized audience members.</li> <li>Student defines terms sometimes but uses technical jargon.</li> <li>Responses to questions from judges and audience are thoughtful and appropriate.</li> </ul>	<ul> <li>Student is not able to communicate research results clearly.</li> <li>Student is not able to avoid jargon or define terms used.</li> <li>Student struggles to answer questions from judges and audience members.</li> </ul>	15
POSTER TOTAL				100

### **Student Awards**

#### 1st Place Winner: \$2,000 College Scholarship sponsored by the United States Army, Navy, and Air Force

Presents research paper at the 2025 National JSHS held in Chantilly, Virginia, from April 22nd through April 26th, 2025.

#### 2nd Place Winner: \$1,500 College Scholarship sponsored by the United States Army, Navy, and Air Force

Presents research paper at the 2025 National JSHS held in Chantilly, Virginia, from April 22nd through April 26th, 2025.

#### The 1st and 2nd place winners have an opportunity to win the following awards at the National JSHS:

- Six \$12,000 undergraduate tuition scholarships, awarded to each 1st place finalist in the National research paper competition
- Six \$8,000 undergraduate tuition scholarships, awarded to each 2nd place finalist in the National research paper competition
- Six \$4,000 undergraduate tuition scholarships, awarded to each 3rd place finalist in the National research paper competition

#### 3rd Place Winner: \$1,000 College Scholarship sponsored by the United States Army, Navy, and Air Force

Presents poster at the 2025 National JSHS held in Chantilly, Virginia, from April 22nd through April 26th, 2025.

#### 4th Place Winner

Presents poster at the 2025 National JSHS held in Chantilly, Virginia, from April 22nd through April 26th, 2025.

#### **5th Place Winner**

Presents poster at the 2025 National JSHS held in Chantilly, Virginia, from April 22nd through April 26th, 2025.

1st Place	Justice Arai	
2nd Place	Anshul Sharma	
3rd Place	Ryan Wang	
4th Place	Audrey Lu	
5th Place	Vishwum Kapadia	
Alternate Going to Nationals	Arunima Bahar	
Best Poster Winner	Gavin Sheppard	

#### Congratulations to the Ohio JSHS 2024 Winners!

#### **Previous Ohio Student Paper Presenters to the National JSHS**

2024	Justice Arai, University School	Anshul Sharma, University School
2023	Sahar Maleki, Hathaway Brown School	Bryn Morgan, West Geauga High School
2022	Mihai Crisan, Upper Arlington High School	Amelia Campbell, Tippecanoe High School
2021	Kaisal Shah, Hathaway Brown School	Laalitya Acharya, William Mason High School
2020	Aditi Kumari, Olentangy High School	Anya Razmi, Hathaway Brown School
2019	Hannah Doris, Sylvania Northview High School	Garret Blum, University School
2018	Arukshita Goel, Sylvania Southview High School	Suraj Srinivasan, Strongsville High School
2017	Arman Serpen, Sylvania Southview High School	Srinath Seshardi, Village Academy, Powell
2016	Graham Lane, University School	Rama Balasubramaniam, Dublin Coffman High School
2015	Pallavi Lanka, Sylvania Southview High School	Srinath Seshardi, Village Academy, Powell

# The Distinguished Teacher Award

Each year, an Ohio teacher is selected to receive The Distinguished Teacher Award. The United States Army, Navy, and Air Force sponsor this award. The recent history of award winners is listed below.

# 2025 Awardee Ms. Tara Henderson, St Ignatius High School

Tara Henderson is in her 19<sup>th</sup> year of teaching biology at Saint Ignatius High School. She mentors students through competitive science fairs, encouraging them to push the boundaries of their knowledge and skill. In the classroom she cultivates a love for science. Her classes are engaging hubs of discovery, where students explore the complexities of biology through innovative labs, interactive methods, and relatable experience. Beyond the classroom, Ms. Henderson is the Moderator of the Health Sciences Program and Pre-Med Society—one of the largest student organizations on campus—she has built a robust platform for students to explore the medical field while promoting service to others. Outside of her academic role, Ms. Henderson finds joy in gardening and cooking, pursuits that not only enrich her personal life but also mirror her nurturing and creative spirit.



	Cumulative Record of the Distinguished Teacher Award
2024	Cristin Hagans, Hilltop High School
2023	Rachel Sanders, Global Impact STEM Academy
2022	Crystal Miller, Hathaway Brown School
2021	Crystal Miller, Hathaway Brown School
2020	Jeremy Nixon, Ottawa Hills High School
2019	Kathryn Nelson, Sylvania Northview High School
2018	Sara Laux, University School
2017	Tyler Bruns, Gahanna Lincoln High School and Rebekah Rice, Gahanna Lincoln High School
2016	Deborah Bogard, Delaware City Schools
2015	Matt Wallschlaeger, Big Walnut High School

#### ACKNOWLEDGEMENTS

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Carmen Dixon

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Tracey Murray Sherri Quinones Doug Shrake Stephanie Gray Wilson

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Annie Witzky Nick Van Horn

Andrew Rogers Mitchell Rosser Jeff Schneider Mary Schneider Doug Shrake Carsyn Stobart Debbie Strozier Brandon Tackett Bradley Taylor Ross Wallace Annie Witzky

#### Many Thanks to the Following Agencies and Organizations for Providing Judges

Abbott Laboratory Air Force Research Laboratory Battelle Capital University Chemical Abstract Services The Ohio State University Past Foundation ROTC

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#### SYMPOSIUM EVALUATION

Please, remember to complete the online evaluation for the 2025 Ohio Junior Science & Humanities Symposium (JSHS). Your input is highly valued and necessary for the continuing success of the Ohio JSHS.

You will receive an email reminding you to take the survey. Thank you in advance for your

cooperation! Thank you so much for your participation in the evaluation of JSHS!