The 61st Annual Ohio Junior Science and Humanities Symposium

JSHS — JUNIOR SCIENCE AND HUMANITIES SYMPOSIUM

Capital University
Ask. Think. Lead.

Columbus, Ohio • March 1, 2024

nsta — National Science Teaching Association

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WELCOME FROM CAPITAL UNIVERSITY'S PROVOST

It is my privilege to welcome you to the 61st 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 May 1-4, 2024 in Virginia Beach, Virginia.

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 61st 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 61st in 2024, 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
Assistant Professor of Education

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

Lieutenant Colonel Christina J. Obergfell

Lieutenant Colonel Christina J. Obergfell graduated from the University of Notre Dame with a bachelor's degree in mathematics and has a master's degree in Operations Research from the Air Force Institute of Technology. She has served in Air Force and Joint leadership assignments throughout the United States. Highlights of her career include working to use mathematical modeling to inform military operations in the Middle East while serving at the United States Central Command and supporting Space System Development for the United States Strategic Command

Lt Col Obergfell is currently the Commander, 338th Recruiting Squadron, Wright-Patterson Air Force Base, Ohio. She leads and directs the recruiting activities of eight enlisted accessions flights with approximately 98 personnel spread across Ohio, Indiana, Kentucky, West Virginia, and Illinois. The squadron's mission is to inspire, engage, and recruit future Airmen and Guardians to deliver air and space power for the United States of America.

STUDENT PRESENTATION SCHEDULE

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9:30 am – 9:50 am

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University School
Effects of Deep Brain Stimulation and Task Difficulty on Visual Search Performance in Parkinson's
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Shreeyans Bhavaraju
University School
Enhancing Neonatal Acute Kidney Injury Prediction in Low-Income Countries: A Machine Learning Approach Integrating Biomarker and Patient Data
Ruff Memorial Learning Center 202

9:55 am – 10:15 am

Niklas Rietsch
University School
The Role of Neuronal Primary Cilia in Alzheimer's Disease
Ruff Memorial Learning Center 07

Ryan Wang
University School
Development of Persistent DNA Vectors for Safe and Lasting Non-viral Gene Therapies
Ruff Memorial Learning Center 102

Elizabeth Theobald
Archbold High School
Trihalomethane Occurrence and Formation within Water Distribution Systems Impacting Public Schools
Ruff Memorial Learning Center 103

Rose Kottapalli
Lima Shawnee High School
A Comparison of the Incidence of Clostridioides difficile Infections across Different Facilities during the COVID-19 Pandemic in Los Angeles, California
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Audrey Lu
Columbus Academy
Predicting Burn Injury Readmissions Using Machine Learning Methods
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Haasini Mendu
William Mason High School
TremorSense: A Novel Parkinsonian Tremor Monitoring and Suppression System
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Alexander Vincenti
University School
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Ruff Memorial Learning Center 102

Weining Wang
University School
Artificial Evolution of Hydrogenase Using Gaming GPUs
Ruff Memorial Learning Center 103

Kara Jones
Central Christian School
Carotenoid Biofortification of Yolks to Produce More Nutritious Eggs
Ruff Memorial Learning Center 201

Chinmay Khare
Ottawa Hills High School
Prediction of Highly Site-Disordered $AgSbI_4$ for Tandem Solar Cells Using Machine Learning and Spherical Cluster Expansion
Ruff Memorial Learning Center 202

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Vishwum Kapadia
University School
Significance of Dicrotic Notch Index in Patients Undergoing Transcatheter Edge-to-Edge Repair
Ruff Memorial Learning Center 07

William Stephans
University School
Interactions between BRAF-mutated and Wild-type Lung Cancer at Varying Doses of Target Drug
Ruff Memorial Learning Center 102

William Wang
Orange High School
Association of Semaglutide with Risk of Suicidal Ideation in a Real-world Cohort
Ruff Memorial Learning Center 103

Julia Dickinson
Hilltop High School
The Effects of Antiperspirant Deodorants on Bacterial Growth
Ruff Memorial Learning Center 201

Evan Dan
Solon High School
Insights of Suicide Factors from Thematic Analysis and Machine Learning-Based Detection of Suicidal Ideation on Reddit
Ruff Memorial Learning Center 202

11:10 am – 11:30 am

John D'Cruz
University School
Live-Cell Imaging to Target Drug Resistance in Multiple Myeloma
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Anshul Sharma
University School
The Impact of Social Vulnerability Index Changes on Overall and Race-Specific Prostate Cancer One-Year Survival Over a 20 Year Period (2000-2020)
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Michael Fioritto
University School
Is a Post-Healing Photogrammetry Scan Clinically Necessary Before Full Arch Implant Restoration?
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Matthew Devine
University School
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Zain Anwar
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Interleukin-34 Deficiency Amplifies Severity of Experimental DSS-Induced Colitis
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Rohan Kumar
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Economic Burden of the Stages of Pediatric Chronic Kidney Disease on the U.S. Healthcare System
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Thomas Blossom
University School
Evaluating the Role of Dietary Inflammation in Aviator Cognitive Fatigue Over Time
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Pranitha Chillara
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Laasya Acharya
William Mason High School
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Zaid Ashruf
University School
Efficacy and Clinical Outcomes of Nirmatrelvir/Ritonavir in Patients with Moderate to Severe Chronic Kidney Disease and COVID-19: A Real-World Data Study

Ryan Chang
University School
Levels of Coliform in the US Campus Wastewater System

Kaileigh Evans
West High School
Investigating the Role of the Unfolded Protein Response in CD8+ T Cell Effector Functions and Exhaustion

Isaiah Gilbert
University School
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Nysha Gupta
Hathaway Brown School
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Ingrid Hoffman
Hilltop High School
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Xuan Huang
Ottawa Hills High School
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The Summit Country Day School
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Christine Kim
Hathaway Brown School
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Hathaway Brown School
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Kingsten Lin
University School
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Mohamed Musa
Sylvania Northview High School
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Reyansh Pardeshi
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Manan Raina
Hawkens Upper School
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Bharath Ramanujam
Dublin Jerome High School
Leveraging Machine Learning to Decipher Key Characteristics of Successful NFL Coaches to Identify Characteristics of Great NFL Coaches

Varun Ramanujam
Dublin Jerome High School
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Ali Sediqe
Ottawa Hills High School
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Gavin Sheppard
University School
Predicting WAR (Wins-Above-Replacement) in Major League Baseball

Bryan Shin
Solon High School
Rational Design and Testing of Natural Hemostatic Hydrogel Using Plant Materials

Anna Spohler
Global Impact STEM Academy
Different Clay Filtration Systems

Nandita Srikumar
Solon High School
Effect of Curcumin and Epigallocatechin-3 Gallate on the Interaction Between CRMP-2, Tau, and CDK5 in Alzheimer's Disease

Christopher Thompson
Ottawa Hills High School
The Dynamics of Aces: A Mathematical Analysis of the Tennis Serve

Nina Van Zandweghe
Solon High School
Using Bidirectional Transformer Neural Networks for Advancing Gender Bias Recognition in STEM Job Advertisements

Ritika Varghese
Sylvania Northview High School
Light-Mediated Difunctionalization of Alkenes for Drug Development

Clarisse Wee
Hathaway Brown School
Location of and Changes in HIF1a Expression in the Retinas of Retinoic Acid Signaling-Inhibited Zebrafish

Margaret Wheeler
Hilltop High School
The Strength of a Zig-Zag Stitch on Different Thread and Fabric Types - A Two Year Study

Gordon Zeitz
University School
Improving the Efficiency of Small Scale Hydropower by Modifying the Turbine Shape

Jennifer Zhang
Hathaway Brown School
The Spread and Regional Characteristics of Covid-19: Evidence from Social Media

ABSTRACTS

Laasya Acharya, William Mason High School
Implementing a Novel Multimodal Neural Network Approach using Dynamic Hyperparameter Selection within an Unmanned Aerial Vehicle for the Early Detection of Crop Diseases
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

As global food demand continues to increase, crops are consistently damaged by diseases, leading to lower crop-yields. Early detection can help mitigate these losses; however, current detection systems are lacking. The proposed-solution allows for the early detection of crop-diseases, both from an aerial and close-up vantage point. The solution consists of a multimodal neural-network that takes in image and video inputs and an unmanned aerial vehicle (UAV) that can autonomously fly and take videos and images. All images and videos (2000 total across 15 crop-diseases) were validated by experts in the field. The dataset was split into 80%/20% for training and testing. The model's image-branch consists of nine layers and the video-branch of six layers. Dynamic hyperparameter selection was established during the training stage, allowing the model to select its own hyperparameters based on the ongoing accuracy. The next stage was testing, which replicated how the model would be employed in the real-life situation. This model was then paired with the UAV, establishing an autonomous method for disease-detection in crops through an AI model. In conclusion, this project shows that a multimodal network with dynamic hyperparameter selection can be developed in conjunction with a UAV for early detection of crop-diseases.

Zain Anwar, University School
Interleukin-34 Deficiency Amplifies Severity of Experimental DSS-Induced Colitis
Oral Presentation: Ruff Memorial Learning Center 07 // 11:35 am
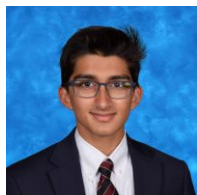
The complex role of Interleukin-34 (IL-34), a ligand for colony-stimulating factor-1 receptor (CSF-1R), in the pathophysiology of inflammatory bowel disease (IBD) remains unexplored. Previous studies have shown elevated IL-34 mRNA expression in IBD patients' inflamed mucosa, and a dual blockade of IL-34 and CSF-1 reduced inflammatory macrophages in dextran sulfate sodium (DSS) induced-colitis. However, blocking IL-34 alone was ineffective, leaving the specific mechanisms of IL-34 regulation in intestinal injury unclear. This study aims to elucidate IL-34's role in the context of IBD, using a DSS-induced colitis model in IL-34 knockout (KO) mice. Age and sex-matched IL-34 KO and C57BL/6 mice were exposed to a fecal homogenization protocol to control for gut flora inter-cage variability, then treated with 2.5% DSS in drinking water over a week. Parameters such as body weight loss, mortality rate, and severity of colitis were observed and recorded, alongside colon samples for MPO and RTqPCR analyses. Fecal DNA extraction and sequencing techniques were used to identify potential alterations in taxonomic composition. The results revealed that IL-34 KO mice displayed enhanced susceptibility to DSS treatment, with a higher mortality rate, significant body weight loss, increased inflammation scores, and shifts in three common probiotic bacterial families. These findings underscore IL-34's potential protective role during acute intestinal inflammation. However, these findings contradict previous studies proposing that IL-34 blockade might confer protection from induced colitis, thus necessitating further investigation into the role of IL-34 in intestinal inflammation and its resolution.

Justice Arai, University School
Designing and Testing UAV Propellers with Serrated Trailing and Leading Edges Inspired by Nocturnal Owl Flight to Reduce Noise and Improve Aerodynamic Performance
Oral Presentation: Ruff Memorial Learning Center 202 // 11:35 am

Drones are infamous for their noise, and unfortunately, growing usage of UAVs across all disciplines have increased noise pollution, negatively impacting human health and the environment. Owls are known for their silent flight, with fringes at the trailing edges and leading edges of their feathers mitigating turbulent eddies, and thus, noise. This feature was implemented in a biomimetic propeller design for this project. The engineering criteria for this project consisted of noise reduction, thrust improvement, and lightweight designs. One control and five modified propellers with serrations were designed and 3D printed by the author, all possessing equal parameters. The trailing edge fringes of the modified propellers being triangular in nature, each modified propeller contained a height to wavelength ratio of 0.3 and 1, respectively. The leading edge had 1:1 height to base ratio. After measuring the thrust and SPL at seven different speeds from 4000 RPM to 1000 RPM, propellers that had both trailing edge and leading-edge serrations were able to reduce noise at all rotational speeds. This project proved that propellers with biomimetic features can reduce their impact of noise pollution, as well as reduce energy consumption in hopes of a more sustainable future.

Zaid Ashruf, University School

Efficacy and Clinical Outcomes of Nirmatrelvir/Ritonavir in Patients with Moderate to Severe Chronic Kidney Disease and COVID-19: A Real-World Data Study

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

This retrospective cohort study evaluates the impact of Nirmatrelvir/Ritonavir (Nm/r) on patients with moderate to severe chronic kidney disease (CKD) infected with COVID-19. Recognizing CKD as a significant risk factor for increased COVID-19 mortality, the study aimed to assess Nm/r's efficacy and the risk of COVID-19 rebound. The study analyzed data from 108 healthcare organizations' electronic health records following the authorization of Nm/r on December 23, 2021. It included three cohorts: 2,607 moderate-severe CKD patients with COVID-19 prescribed Nm/r, 194,208 similar CKD patients not prescribed Nm/r, and 32,562 high-risk non-CKD patients with COVID-19 treated with Nm/r. All patients were matched for demographic variables and comorbidities. The primary goal was to compare clinical outcomes such as hospitalization, emergency department visits, ICU admission, mechanical ventilation/intubation, and mortality over 6 and 12 months between CKD patients given Nm/r and those who were not. The secondary objective was assessing the risk of COVID-19 rebound within 5-14 days post-Nm/r prescription in CKD patients compared to non-CKD high-risk patients. Results showed Nm/r significantly reduced hospitalization, emergency department visits, ICU admissions, mechanical ventilation, and mortality in CKD patients. However, it also revealed a higher risk of COVID-19 rebound in CKD patients compared to high-risk non-CKD patients. While Nm/r is effective in reducing hospitalization and mortality in moderate-severe CKD patients with COVID-19, it increases the risk of COVID-19 rebound. This calls for further research into Nm/r's interactions and efficacy in dialysis-dependent patients.

Anneysha Arunima Bahar, Ottawa Hills High School

First Star Expansion: The Beginning of The Universe

Oral Presentation: Ruff Memorial Learning Center 202 // 11:10 am

The halos formed in the beginning of the universe hide the mysteries of the evolution of the universe to have reached where it is today. This paper aims to find a mathematical model that tracks the ever-expanding nature of halos through a basic model in order to be able to create conclusions about how they have evolved. JUPYTER notebook is used with its matplot library and numpy library functions in order to plot, order and sort samples. Visuals and data organization is then done to find the expansion of the halo through mathematical calculation. Halo metallicity is tracked, and hence a metallicity cube is used with Renaissance Simulation data. The model used is one created by infinitesimally small '.' markers that are used to fill up the halos. The halo areas and radii are then tracked to try and understand relationships present among these early halos. Results show that these halos are much smaller than expected values, with a high left skew in terms of areas. Results also show that the halo radii follow the normal model, which suggests the halo radii might be a random variable. Future progress will entail expanding the halos through time and fitting differential equations through them in order to create a more robust model.

Shreeyans Bhavaraju, University School

Enhancing Neonatal Acute Kidney Injury Prediction in Low-Income Countries: A Machine Learning Approach Integrating Biomarker and Patient Data

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

Affecting a staggering 18-70% of critically ill neonates, Acute kidney injury (AKI) is a serious health concern, particularly in low-income countries. This project aims to address the lack of effective AKI prediction in these regions by designing a specialized Artificial Intelligence model. The dataset, sourced from 11 medical centers in India, offers a unique perspective on neonatal AKI prediction in resource-limited settings. The model, leveraging an eXtreme Gradient Boosting algorithm with a StandardScaler Wrapper scaling tool, utilizes a diverse range of patient data, including biomarkers, detailed patient profiles. The model achieves impressive performance metrics with an F1 score of 92.9%, recall of 93%, accuracy of 93%, precision of 93.2%, and an Area Under the Curve (AUC) of 96.96%, showcasing its robust predictability and applicability in hospital settings. While acknowledging these successes, the study highlights challenges related to dataset size and imbalance, emphasizing the imperative for ongoing refinement. Future goals involve enhancing the model's predictive capabilities through fine-tuning and creating a user-friendly interface for seamless integration into medical practices. This solution holds the potential to significantly improve early AKI prediction, facilitating timely interventions for infants and serving as a valuable tool for healthcare professionals in resource-constrained environments.

Thomas Blossom, University School
*Evaluating the Role of Dietary Inflammation in Aviator Cognitive Fatigue Over Time*
Oral Presentation: Ruff Memorial Learning Center 103 // 11:35 am

Aviators who are exposed to multiple military flights have been found to experience cognitive fatigue post-flight. This cognitive fatigue poses a threat to aviator safety and performance. Increased levels of proinflammatory cytokines have shown a correlation to greater cognitive fatigue levels. Various outside factors such as sleep or diet could also affect this cognitive fatigue. The goal of this analysis is to examine factors that contribute to increased levels of daily dietary fluctuations and their relation to cognitive fatigue. Aviators (n = 28) were assessed 12 times over two weeks (Starting Sunday, excluding Saturday) in which they had regularly scheduled sorties. The assessment included a 24-hour diet recall and a self-administered five-category multidimensional fatigue index (MFI) test. Aspects of the fatigue levels test were examined to look for relationships with dietary inflammation scores (DIS). These scores were obtained using each dietary component's calculated weight based on their strength of association with proinflammatory biomarkers. Scores are summed using each component's weight and can be negative (anti-inflammatory) or positive (pro-inflammatory). Aviators were analyzed separately based on weeks (1 and 2). No significant differences in DIS were found when compared to perceived general fatigue scores for either week. Also, there were no significant differences between perceived physical and general fatigue scores and DIS for either week. However, physical fatigue averages trended upward over the two weeks. This suggests that further interrogation of the study could reveal significant relationships between this dietary inflammation and fatigue.

Ryan Chang, University School
Levels of Coliform in the US Campus Wastewater System
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm
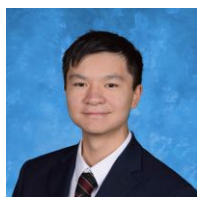
Coliform bacteria are commonly found in the aquatic environment and soil, and thus can be used as indicators of contamination of food and drinking water. Contaminated water can lead to health risks including cholera and typhoid. This research aims to determine the coliform levels in the local water waste system. 4 bottles containing water samples were filled at the wastewater drain and the three polishing ponds. A micropipette was used to pipette 100 mL samples from each bottle into 3 coliform plates. All 12 plates were stacked and incubated at 32°C for at least 48 hours. The plates were stored in the refrigerator until the number of colonies was analyzed. For the 3rd and 4th data collections, the water samples were diluted to a 1:1 ratio of pond water and purified water so that coliform colonies could be more easily counted. Coliform colonies were counted if they were darker and larger compared to the surrounding bacteria. The hypothesis was that the number of definitive darkened coliform colonies would decrease and the number of smaller and more individual colonies would increase from the output to Pond 3, and the hypothesis could be supported for all but the first data collection.

Pranitha Chillara, Dublin Coffman High School
A Comparison of Root Microbiome Diversity and Leaf Protein Concentration in Hydroponic and Soil-Cultivated Lettuce
Oral Presentation: Ruff Memorial Learning Center 201 // 11:35 am

Hydroponic farming protects vulnerable farmland from degradation and increases food security in regions unsuitable for traditional farming methods; however, it requires a significant economic investment. Therefore, evaluating the potential benefits is crucial, as they could incentivize more farmers to adopt hydroponic farming. This study compared the root microbiome diversity and leaf protein concentration between hydroponic and soil-cultivated lettuce to determine the impact of the lettuce cultivation method on plant health and nutrition. The hypotheses were that hydroponic cultivation would decrease root microbiome diversity but increase leaf protein concentration compared to soil-based cultivation. Lettuce was cultivated using hydroponic cultivation in a vertical tower, soil-based cultivation in a vertical tower, and soil-based cultivation in a repurposed milk carton. DNA Extraction, PCR Amplification, and Gel Electrophoresis visualization were used to analyze root microbiome diversity, while protein concentration (mg protein/mL solution) was estimated using the Biuret Method. The results indicated that the soil-cultivated lettuce exhibited higher root microbiome diversity, while the hydroponically-cultivated lettuce exhibited higher leaf protein concentration. These findings suggest that the cultivation method impacts the root microbiome diversity and leaf protein concentration in lettuce. Future studies should explore the long-term implications of hydroponic farming on sustainability and understand how different crops are affected by hydroponic environments.

Evan Dan, Solon High School
Insights of Suicide Factors from Thematic Analysis and Machine Learning-Based Detection of Suicidal Ideation on Reddit
Oral Presentation: Ruff Memorial Learning Center 202 // 10:45 am

Suicide is a growing public health concern, exhibiting an increasing mortality rate across various cultures and regions. This study employs Natural Language Processing (NLP) and machine learning (ML) techniques to identify the intricate motivations behind suicidal tendencies. Focusing on the Reddit community r/SuicideWatch — a platform where individuals express suicidal thoughts — the research analyzes 232,074 posts (Dec 16, 2008 - Jan 2, 2021) from r/Teenagers and r/SuicideWatch, sourced from Kaggle [1]. We utilized word clouds, sentiment analysis, and thematic analysis techniques like heat maps, correlation, and factor analysis to understand the impacts of different factors. For instance, the prevalent use of negative language in r/SuicideWatch sharply contrasts with the neutral tone in r/Teenagers. Thematic analysis reveals key issues like trauma, domestic problems, academic stress, economic hardship, social pressures, and cyber-related concerns. Notably, heat maps underscore academic and social issues, while correlation matrices reveal strong connections between suicide and the academic/trauma themes. Factor analysis highlights the significance of environmental factors (domestic and social pressures) and personal situations (academic and economic challenges) in this context. Furthermore, a fine-tuned BERT model achieved a validation accuracy of 0.95211 and F1 score of 0.93719, which achieved a test accuracy of 0.95309 and an F1-score of 0.93834. In conclusion, the study underscores the nuanced relationship between suicide and various themes in these communities. It also showcases the potential of ML techniques in detecting suicidal ideation, offering valuable insights for developing more effective support and targeted treatments for individuals grappling with suicidal thoughts.

John D'Cruz, University School
Live-Cell Imaging to Target Drug Resistance in Multiple Myeloma
Oral Presentation: Ruff Memorial Learning Center 07 // 11:10 am
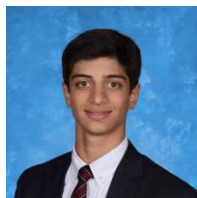
Multiple Myeloma (MM) remains an incurable cancer characterized by malignant plasma cells that synthesize and secrete excessive monoclonal proteins. Because MM cells create so many proteins, they rely heavily on the proteasome system to degrade proteins that are misfolded, to maintain protein homeostasis. Proteasome inhibitors (PIs) leverage this by inhibiting the function of proteasome catalytic subunits, leading to the accumulation of ubiquitinated proteins in the endoplasmic reticulum (ER), triggering ER stress, and culminating in apoptosis. PIs have transformed MM therapy and doubled overall survival (OS), but patients inevitably develop resistance. Overexpression of *PSMC2*, a regulatory ATPase within the proteasome, is associated with reduced OS in MM patients. Here, we conducted *in vitro* experiments using live-cell imaging to determine if *PSMC2* overexpression promoted PI-resistance in MM cells. We overexpressed *PSMC2* in ARH77 and U266 MM cell lines using a third-generation FLAG-tagged lentivirus and compared to empty vector controls. Cells were treated with bortezomib or the ER stress-inducer tunicamycin, and viability was assessed by propidium iodide staining utilizing the IncuCyte Live-Cell Imaging System. To quantitate ER stress, cells were transfected with a baculovirus-derived ER stress reporter and treated with bortezomib or tunicamycin before analysis via flow cytometry. Results demonstrated that *PSMC2* overexpression led to reduced ER stress and apoptosis in MM cells when challenged with drugs, suggesting that *PSMC2* overexpression promotes drug resistance in MM cells. Taken together, our results demonstrate that *PSMC2* is a negative prognostic biomarker, promotes drug resistance, and represents a novel, actionable, target to treat MM.

Matthew Devine, University School
UV Photodegradation of Byssal Thread Adhesives on Acrylic, Polystyrene, and Aluminum Substrates
Oral Presentation: Ruff Memorial Learning Center 201 // 11:10 am

Zebra mussels (*Dreissena polymorpha*) are invasive to Lake Erie. Mussels are filter feeders, adhering to substrates/surfaces below water level in order to obtain food. The primary reason these mussels are problematic is the adhesive they secrete. Their ability to adhere to all surfaces, including water intake pipes and boats inhibits their proper functioning and greatly increases the cost of operations on the lake. This study observes the effects of ultraviolet radiation on chemically similar synthetic adhesives that models the foot protein of the well-studied Mytilus edulis foot protein (MEFP). Due to ultraviolet photodegradation, it is expected that the synthetic model's adhesive will not set when subjected to UV light exposure while curing. Two adhesive models were tested: a polymer of catechol solution (0.058M) and PEI solution (0.052M), and a polymer of catechol solution (0.029M) and PEI solution (0.052M). The adhesives were tested with and without UV treatment on three substrates (aluminum, acrylic, and polystyrene). With UV treatment, no adhesives successfully adhered on any of the substrates. On the polystyrene and acrylic samples with catechol and PEI adhesives, both adhesives successfully set. UV treatment resulted in decreased tensile strength compared to control (t test p = 0.0017; p = 0.015, respectively). Both catechol polymers exhibited decreased tensile strength after UV treatment (Polystyrene t test p = 0.019), (Acrylic t test p = 0.0015). This data supports the hypothesis that UV treatment can be used as both a preventative treatment and an active treatment for mussel adhesives.

Julia Dickinson, Hilltop High School
The Effects of Antiperspirant Deodorants on Bacterial Growth
Oral Presentation: Ruff Memorial Learning Center 201 // 10:45 am

The main purpose of this experiment was to test two different types of antiperspirant deodorants. The difference was between two active ingredients: aluminum chlorohydrate (AC) and aluminum sesquichlorohydrate (ASCH). They were being tested to see how much bacteria was present, before and after being applied to the axial region. The hypothesis stated that when AC and ASCH were applied, the ASCH would suppress the most bacteria growth, because there is hydrochloric acid being present. The 10 participants were asked to shave their armpits, and not wear deodorant for that day prior to testing. The experimenter then swabbed each armpit, and applied the swab to the nutrient agar petri dish. The experimenter then applied one of the antiperspirants to the right armpit, and the other was for the control. The subjects then did a 5-minute workout, and then each armpit was swabbed again and applied to the petri dish. Colony forming units (CFU) and area of bacteria coverage were recorded. The hypothesis was partially supported, because the AC had less CFU's (35.5) compared to 123.4 for ASCH. However, ASCH had less coverage (.81%) compared to 13% for AC. Statistically, the only significant difference was shown in decreasing the coverage of bacteria in the ASCH samples versus the control (p = .0182).

Kaileigh Evans, West High School
Investigating the Role of the Unfolded Protein Response in CD8+ T Cell Effector Functions and Exhaustion
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

My research in this project revolved around XBp1s over-expressing CD8+T-Cells. T-cells are activated by three different signals: TCR-MHC interaction, co-stimulatory molecules, and cytokines. We investigated the role of the Unfolded Protein Response and how it aids the activation of cd8+ T-Cells. We used CD3/CD28 Dyna Beads in vitro to stimulate our cells. Then we conducted flow Cytometry. Some cell markers we looked at are Cd62L, CD127, CD44, CD69, KLRG1, PD1, and TIM3. This project has shown us that XBP1s over-expressing cells have more of an effector/effector memory appearance. We have also seen a reduction in cell activation and a suppression of cell function.

Michael Fioritto, University School
Is a Post-Healing Photogrammetry Scan Clinically Necessary Before Full Arch Implant Restoration?
Oral Presentation: Ruff Memorial Learning Center 103 // 11:10 am
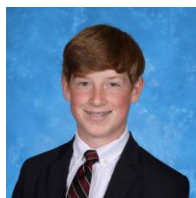
Dental implant surgery and subsequent restoration of the implants are technique-sensitive procedures, so minimizing failures as much as possible is vital. Failures occur due to how the prosthetic fits onto the implants, with little errors adding up throughout the whole procedure. If you take a post-surgical photogrammetry scan, then the long-term success of implants and prosthetics will be greater because it captures any positional change between surgical and post-healing stages. The research was conducted by taking post-surgical and post-healing scans and overlaying the scans in Cloudcompare software; Cloudcompare produced a graph with the mean and standard deviation for positional change in the implants. The data was converted to microns, and if the standard deviation was over 80μm, then this is past our threshold of acceptability, and the case would be at high risk of failing. 20% of the cases were above the 80μm movement threshold. 4 cases were above the 80μm positional change threshold, and 3 were over the 120μm upper limit. This data shows the post-healing photogrammetry scan should be considered clinically necessary. A potential 20% failure rate is far too high in surgery or dentistry. A future study that could be done is to take some of the cases that were above the threshold, 3d print models and put them through continuous load testing to see if they fail in vitro.

Isaiah Gilbert, University School
Plasmid Synthesis from Bacteria for DNA Nanostructure Production
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

Deoxyribonucleic Acid (DNA) origami is a nanotechnology that utilizes the principles of base pairing in DNA molecules to create intricate and precise nanostructures. DNA origami allows for the incorporation of various functional elements, such as proteins, nanoparticles, or chemical groups, to give the finished structures specific properties and/or functionalities. The overall aim for this project is to create DNA origami nanostructure that encodes a specific plasmid sequence. The way that this would be done is to first create purified plasmids from bacteria samples, and then utilize these purified plasmids in order to make our DNA origami nanostructure. In this project, bacteria was initially taken from a smaller sample and placed into growth media and incubated overnight to grow the sample. Plasmid purification was then conducted by using a miniprep kit. Then, these plasmids were used in the process of making DNA origami nanostructures. The procedure was successful in the creation of DNA origami nanostructure for later research. Our results identified the best methodology for growing bacteria to optimize plasmid production. My work was able to recommend that 16 hours of bacterial incubation is ideal to increase plasmid production. Our procedure was successful as we produced the plasmid of choice and assembled DNA nanostructures. This research's community impact is large as it impacts the field of cancer research, potentially giving us access to a safe drug delivery system and to reducing the side effects of chemotherapy, thus making cancer treatment a safer and smoother process all around. This means that not only would DNA nanotechnology be impacting the field of cancer research, but also the field of medicine as a whole due to its capability to be a new drug delivery system.

Nysha Gupta, Hathaway Brown School
The Effect of MRP14 on Systemic Lupus Erythematosus (Lupus Nephritis)
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

Using transcriptional profiling of platelets from patients presenting with acute myocardial infarction, Dr. Yunmei Wang identified myeloid-related protein-14 (MRP14) as an acute myocardial infarction gene and reported that platelet MPR14 binding to platelet CD36 regulates arterial thrombosis. Through murine models it was also determined that MRP14 plays a role in venous thrombosis. However, whether MRP14 plays a role in systemic lupus erythematosus is unknown. WT and MRP14 deficient (MRP14 -/-) were subjected to SLE through gene mutations. Glomerular, tubular, and interstitial cell health and inflammation was measured in both models using kidney sections and periodic acid-Schiff (PAS) staining. The MRP14 -/- mice had increased cell health and decreased fibrosis indicating that neutrophil and platelet derived MRP14 directly regulates SLE.

Ingrid Hoffman, Hilltop High School
People's Palatability Preferences of Gluten Free Pie Crust Flours
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

The purpose of this experiment was to determine the palatability and digestibility of tapioca, almond, coconut, sorghum, potato, and a gluten free flour blend that was created in this project. Research hypothesis (H1) was that the gluten free blend flour would score the highest average rating among the flour types in palatability through a preference survey. Research hypothesis (H2) was that the gluten free blend flour would be the most digestible flour compared to sorghum, coconut, almond, and potato flours by having the highest average mass loss post digestion. Research hypothesis (H3) was that gluten free flour blend would have the lowest score on a digestion survey compared to sorghum, coconut, almond, potato, and tapioca flours. Six types of flour were baked into pie crusts and sampled by 66-98 participants. Participants ranked their preferences on a 5-point Likert scale survey based on four criteria. An hour after consuming the crust, participants answered six questions in regards to digestion. These results were averaged and compared. In a separate digestibility test, the crusts were placed in glass containers filled with 30 mL of gastric juice and placed on a rotator that moved at 100 rpm for seven hours to simulate a stomach. Samples were placed on a counter to dry for three days, pre and post masses were compared in grams. In the palatability experiment, the researcher rejected research hypothesis (H1) as the gluten free flour blend had the fourth highest overall palatability score of 10.9 and was determined not significant using an unpaired t-test (p = 0.4236). In the digestion trials, the researcher rejected H2 and failed to reject H0 of H2. The researcher proposes the hypothesis that coconut flour would have the greatest mass loss (1.78g). The researcher failed to reject research hypothesis (H3) as the gluten free flour blend had the lowest average score on the digestion survey with a score of 1.75. Research continues to create a digestible and palatable flour blend.

Xuan Huang, Ottawa Hills High School
Exploring the Viability of Substituting Copper Doping with Silver Doping in CdTe Solar Cells
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm
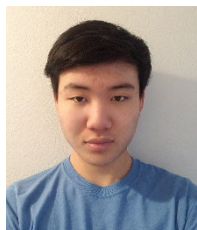
The most popular p-layer doping agent used in CdSeTe solar cells is copper; however, copper has some limiting factors including a low concentration of Cu carriers in the conduction band in comparison to copper in the valence band. This project investigates the viability of a possible p-layer dopant, silver. There is currently no published material on Ag-doped CdSeTe but reports on CdTe cells have claimed similarities between silver and copper with silver performing worse. CdSeTe filmstacks sourced from both UToledo's PVIC and First Solar were doped using aqueous solutions of $AgNO_3$ and $CuCl_2$, thermally treated, and gold deposited. JV and EQE measurements at t = 0 were the primary form of measurements taken. Results from the most promising batch of 14 coupons demonstrated that Ag-doped cells can be very comparable with Cu-doped cells, but with different construction: the highest cell efficiency for Ag was 17.9% whilst the highest cell efficiency for Cu was 17.3%. It was found that optimally doped Ag-doped cells require around double thermal annealing time and less solution concentration by an order of magnitude compared to Cu-doped cells.

Kara Jones, Central Christian School
Carotenoid Biofortification of Yolks to Produce More Nutritious Eggs
Oral Presentation: Ruff Memorial Learning Center 201 // 10:20 am

Biofortification increases the nutritional value of food crops by increasing the vitamin and carotenoid content. The objective of this research was to determine if a feed supplement including a high carotene containing fruit in combination with high xanthophyll containing petals could be used to produce a more nutritious quail egg that contains higher levels of both provitamin A (β-carotene, β-cryptoxanthin) and non-provitamin A (lutein, zeaxanthin) carotenoids important for human health and vision. Treatments included poultry feed only (control) and five supplements: marigold petals+tomato fruit, squash, squash+marigold, pumpkin, and pumpkin+marigold. Yolk color was measured using the yolk fan, and the carotenoid content of yolks was measured using high performance liquid chromatography. All feed supplements resulted in darker yolks with higher yolk fan scores than controls. Yolks from all treatments containing marigolds had higher levels of lutein and zeaxanthin than the individual squash or pumpkin treatments. Pumpkin+marigold had significantly more β-cryptoxanthin than control yolks. All the supplements resulted in β-carotene deposition in the yolks, while controls had no detectable β-carotene. Combining marigold petals with orange fruits resulted in deposition of both provitamin A and non-vitamin A carotenoids in yolks, resulting in more nutritious eggs than quail diets with individual supplements.

Zaina Kamran, The Summit Country Day School
Social Media Usage Among Adolescents Does Not Impact Image Scrutiny
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

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 number of social media apps an adolescent has affects their ability to analyze and identify different edited photos. The goal of this study was to see if a relationship exists between adolescents who use social media often and their ability to scrutinize photos through identification of edited details in an image. 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. We then asked participants to identify different edited details among three variations of one image. No significant difference was found between usage of social media apps and the mean number of correctly identified edited features. No significant difference was found based on scrolling and posting behaviors while using social media and the mean number of correctly identified edited features. Despite social media usage not affecting the participants ability to correctly identify edited features, this study is still important because it emphasizes possible limitations and how it affected the study's result such that 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.

Vishwum Kapadia, University School
Significance of Dicrotic Notch Index in Patients Undergoing Transcatheter Edge-to-Edge Repair
Ruff Memorial Learning Center 07 // 10:45 am

Mitral regurgitation (MR) is the backflow of blood from the left ventricle to the left atrium caused by a leak in the mitral valve. MR can lead to shortness of breath, heart failure, and death. Transcatheter edge-to-edge repair (TEER) has emerged as an option for percutaneous mitral valve repair. The dicrotic notch index (DNI), a feature of the aortic pressure waveform, has not been studied in the context of TEER outcomes and success. This retrospective study analyzed 145 patients that underwent TEER between 2019 and 2022. DNI was calculated from invasive aortic pressure waveforms. Forward stroke volume (SV) was measured using echocardiography. Pearson's test measured the correlation between change in DNI and forward SV, and multivariate linear regression was performed to identify predictors of DNI change. The cut point for change in DNI was determined and used to compare differences in clinical outcomes. DNI significantly increased post-TEER (0.49 ± 0.11 to 0.52 ± 0.11, $p < 0.001$), and the increase in DNI correlated with improved forward SV ($r = 0.30$, $p < 0.001$). Multivariate analysis identified change in forward SV as the independent predictor of DNI change ($p = 0.002$). A cut point of 2.71% change in DNI identified higher probability of event-free survival at 1 year. DNI increases with the treatment of MR after TEER, and this increase correlates with an increase in forward SV. The increase in DNI is associated with better clinical outcomes. Taken together, DNI provides a simple and practical measure of TEER efficacy. Prospective multicenter studies are still needed to validate these findings.

Chinmay Khare, Ottawa Hills High School
Prediction of Highly Site-Disordered AgSbI$_4$ for Tandem Solar Cells Using Machine Learning and Spherical Cluster Expansion
Oral Presentation: Ruff Memorial Learning Center 202 // 10:20 am

Research in renewable energy, specifically solar cells, is of critical importance. Single-layer solar cells have reached their limits on efficiency. Tandem (multi-layer) solar cells can double the efficiency. Non-toxic metal halides are of current interest as light-absorbers in the low-wavelength range of the AM1.5G spectrum. Recently synthesized AgSbI$_4$ is such a material. Due to its experimentally-observed high site-disorder, its development is slow; its crystal structure can only be computationally determined. In AgSbI$_4$, this site-disorder results in over 21 million structures in 12 space groups. Density functional theory (DFT) is the standard method to compute material properties. Performing resource-expensive DFT calculations of all 21 million structures of AgSbI$_4$ is computationally impossible. Therefore, a spherical cluster expansion with a kernel ridge regression machine-learning (SCE-KRR-ML) model was developed. The SCE-KRR-ML model gives a prediction accuracy of 98% compared to DFT calculations. The model was used to select 5 low-energy structures. Expensive DFT calculations were performed on these 5 structures to thoroughly characterize AgSbI$_4$'s structural and optoelectronic properties, including X-ray diffraction, electronic band gaps and structures, effective masses, density of states, Crystal Orbital Hamilton Populations, and absorption and reflectivity spectra. Band gaps were determined to be ~2.02 eV, which matched the experimental value of ~1.92 eV. We find the 5 structures to have properties agreeable with experimental data. The high absorption coefficient of AgSbI$_4$ in the low-wavelength range of the AM1.5G spectrum and small electron effective mass makes it a potential absorber material in multi-layer solar cells.

Christine Kim, Hathaway Brown School
The Effects of Fatty Acids and Isocitrate Dehydrogenase 1 (IDH1) Inhibition on Pancreatic Cancer
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm
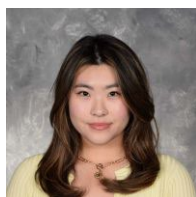
Pancreatic ductal adenocarcinoma (PDAC) is the 3rd leading cause of cancer-related deaths in the U.S. There is an overall survival rate of less than 3% within 5 years and a 66% survival rate in Stage 1 PDAC. Compared to other cancer subtypes such as melanoma, which has a 99% survival rate within Stage 1, PDAC shows astonishingly low survival results. In recent years, a major emphasis has been on combination therapies with ketogenic diets. Previously we illustrated that PDAC growth is suppressed when the levels of reactive oxidative stress (ROS) are increased through the inhibition of the Isocitrate dehydrogenase 1 (IDH1) enzyme. We hypothesized the major source of ROS production in ketogenic diets arose from the circulation of fatty acids. Treatment of ketogenic diets with AG-120 has shown increased potency compared to monotherapies. Through a series of investigations, we learned that among the components of a ketogenic diet (high fat and ketone bodies, low glucose and insulin), high fat showed the strongest affinity towards anticancer effects. This study also tested fatty acids in the cell culture of PDAC in the presence and absence of IDH1. Our results indicated that in the presence of IDH1, PDAC cells demonstrated decreased sensitivity to the presence of fatty acids. However, when IDH1 was knocked out, PDAC cells struggled to proliferate when treated with fatty acids. For future directions, we will investigate the underlying pathways that cause PDAC cell death (apoptosis, ferroptosis, necrosis) in the presence of fatty acids and the absence of IDH1.

Ishita Kopparapu, Hathaway Brown School
Testing a Novel Stem Cell Culturing Medium for Cortical Organoids
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm
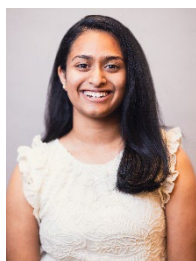
Organoids are a 3D stem cell model which recapitulate the physiology of human organs. Animal models such as mice have limitations due to the inaccurate representation of the human brain. 2D models such as iPSC-derived cell types only capture one or two cell types whereas organoids present a unique model as they are closer to a human organ's physiology in composition and cell-to-cell interactions. Thus organoids allow human diseases to be tested in the most human-like model. The purpose of this project was to optimize a cortical organoid differentiation protocol to be implemented in neurodevelopment and further disease progression studies. This project builds off a protocol for cortical organoids that has cost effective advantages by using a novel stem cell media supplement provided to our lab that is considerably cheaper. In this project, embryonic stem cells were cultured until completely confluent and later differentiated into cortical organoids to study neurodevelopment. Two culturing media, an established commercial media and a novel commercial media, were tested and when observing the organoids, growth and cell type antibodies were studied to identify neurodevelopment and progression of differentiation. Preliminary results showed that at day 30, progenitor cells within the organoid began to migrate for both types of media. During the differentiation process, the novel commercial media showed more neural rosettes compared to the established commercial media. Neural rosettes indicate neural development as they are known to be representative of the neural tube. Future directions include testing new cell plating methods and comparing iPSC to ESC differentiation.

Rose Kottapalli, Lima Shawnee High School
A Comparison of the Incidence of Clostridioides difficile Infections across Different Facilities during the COVID-19 Pandemic in Los Angeles, California
Oral Presentation: Ruff Memorial Learning Center 201 // 9:55 am

During the first surge of the COVID-19 pandemic in 2020, hospitalized COVID-19 patients were frequently prescribed broad-spectrum antibiotics. The overuse of antibiotics often results in an imbalance of gut microbiota, which can cause antibiotic-associated diarrhea. Severe forms of antibiotic-associated diarrhea are usually caused by a *Clostridioides difficile* infection (CDI) and can cause severe gastrointestinal disease inflammation of the colon, and may lead to worse COVID-19 outcomes. Limited research has investigated the relationship between CDI and COVID-19 in a region with high population density. This retrospective study investigates the incidence of CDI across Acute Care, Long-Term Acute Care (LTAC), and rehabilitation facilities in Los Angeles County, California, before and during the pandemic (January 2017-December 2022). This study used data from the 2017-2022 California Department of Public Health's (CDPH) CDI database. The findings indicated that the mean Standard Infection Ratio (SIR) of CDI increased by 0.05 (9.62%) in the second half of 2020, with the largest increase in LTAC facilities. However, the mean CDI remained relatively stable from 2021-2022 when combining all facility types. In the future, it is important to consider preventive measures for CDI in LTAC facilities and during new outbreaks of COVID-19.

Emerson Krauss, University School
Evaluating Homemade Protein and DNA Ladders as Molecular Weight Markers for Size Exclusion-Chromatography
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

Creating a protein ladder would efficiently cut down lab prices while still managing to create accurate measurements of different proteins. Past homemade protein ladders did not attempt to use the ladder for chromatography. Past homemade DNA ladders have omitted steps of expressing the cell culture to get the plasmids used in the DNA ladder. Observing the size of the protein or plasmid is also essential to better understanding the structure of these molecules. The methods for the creation of the protein weight markers are divided into two main steps: Expression and Purification. The methods for creating the DNA weight markers similarly have the step of expression and purification, but contrast by the cutting of the plasmids. Expression is the same by growing the cell culture I need. I consider both ladders partially successful. The protein weight markers were visible and migrating on par with the commercial protein ladder suggesting to be a viable alternative. The DNA ladder migrated properly although the plasmids were a little faint. HPLC did not work out possibly due to incompatibility of the proteins to the HPLC machine.

Rohan Kumar, University School
Economic Burden of the Stages of Pediatric Chronic Kidney Disease on the U.S. Healthcare System
Oral Presentation: Ruff Memorial Learning Center 102 // 11:35 am
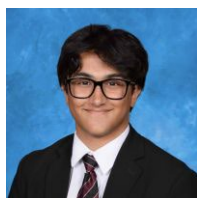
Pediatric chronic kidney disease (CKD) plays a role in burdening the public health system. Some of this burden can be attributed to comorbidities frequently associated with CKD; however, much of the economic burden is attributed to CKD itself. The economic burden of CKD is difficult to estimate due to variability in the reporting of costs in the literature. In addition, few studies have endeavored to estimate the cost of CKD in the pediatric population, as CKD is not commonly diagnosed in children until the symptoms are observed. Therefore, we extracted data from The Pediatric Health Information System Database (PHIS) to evaluate if the length of stay, hospitalization cost, morbidity, and mortality is higher in patients with CKD than in patients without CKD and to determine if these variables increase over the CKD stage. We found that length of stay (LOS) and hospitalization costs are increased relative to a typical hospitalization. The LOS for patients with CKD 4 and CKD 5 were 22% and 50% longer relative to the LOS of a typical hospitalization, and the cost for these hospitalizations was 128% and 163% higher than that of a typical hospitalization. Morbidity and mortality remain constant through the various stages of CKD. Further investigation is imperative to decrease the financial burden on both patients and the US healthcare system.

Kingsten Lin, University School
Designing a High Precision Contactless Displacement Tracker for Use in MDBM Prototyping
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm
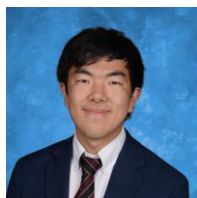
Magnetically Deflected Ballistic Mass (MDBM) is a theoretical technology that involves the levitation and acceleration of a ferromagnetic mass within a vacuum system. Since friction is not present within the system and air resistance is minimal, this technology serves as a lossless battery. For MDBM to be usable, numerous features still have to be designed, such as a control system to keep the mass in the center of the tube. Previous research on a potential control system was successful in stabilizing a levitated mass in one dimension but faced difficulty in upscaling to a second dimension due to build constraints; the position sensor that was used could not work on two axes. Additionally, the friction from that sensor seemed to have hurt consistency in the experiment. Hence, this project aims to solve those problems by creating a sensor that works in two dimensions and is contactless. This prototype shined a laser at a reflective sphere, amplifying any displacements, after which the resulting position of the laser was captured by a camera. Simulations of the concept were successful. Unfortunately, building the prototype was done imprecisely, and the sensitivity of the system resulted in inaccuracies that led to the inability to verify the prototype's precision in the real world. Still, with an improved procedure, much better results could be obtained. With a more rigid prototype, precision to the tenth of a millimeter could very well be achieved by the built sensor, an impressive feat, especially considering the low cost of the prototype.

Audrey Lu, Columbus Academy
Predicting Burn Injury Readmissions using Machine Learning Methods
Oral Presentation: Ruff Memorial Learning Center 202 // 9:55 am

Hospital readmission rates are crucial indicators of hospital efficiency and the quality of patient care. While certain readmissions are unavoidable, many can be prevented, potentially easing the financial burden on families and government healthcare systems. Despite the unique risks and costs associated with burn injuries, few studies have investigated related readmissions. Our research addresses this gap by evaluating the predictive accuracy of five widely used machine learning methods in forecasting readmission rates related to burn injuries through extensive simulation studies with various factors such as sample size, number of features, data dependency structures, and readmission rate prevalence. Our findings reveal that Support Vector Machine and Random Forest methods demonstrate the highest accuracy when the data signal is strong, and logistic regression models could perform competently in scenarios with weak data signals. We apply these methods to the Nationwide Readmissions Database (NRD) and employ a random under-sampling strategy due to the significant data imbalance and a low readmission prevalence. Overall, the Random Forest method emerged as the most effective predicting method. We further identify five key factors influencing readmission likelihood: longer initial hospital stays and the absence of emergency department services at discharge increase readmission rates while being located in a major metropolitan area, initial weekend admissions, and primary insurance coverage through Medicaid or private providers are associated with reduced readmission rates. These insights offer valuable guidance for physicians and policymakers in formulating strategies and guidelines to mitigate burn-related readmissions.

Haasini Mendu, William Mason High School
TremorSense: A Novel Parkinsonian Tremor Monitoring and Suppression System
Oral Presentation: Ruff Memorial Learning Center 07 // 10:20 am

Parkinson's disease (PD) is the second most common neurodegenerative disorder. Tremors, which affect over 70% of PD patients, significantly disrupt daily activities of living. Currently, tremors are managed through medications, but dosing is based on subjective clinical assessments, which fail to capture PD's fluctuating course. There is a need for a wearable and quantitative tremor monitoring system to aid medication dosing. I hypothesized that I could develop an inexpensive and lightweight closed-loop tremor monitoring and suppression system using an accelerometer and vibration motors, which stimulate pressure-sensitive skin receptors distracting the brain from the dysregulated tremor feedback loop. To measure tremor frequency and intensity, I used an Arduino Nano 33 BLE. Tremors were detected using a frequency threshold. The frequency threshold was identified using an age-and sex-matched accelerometery dataset of patients from the Michael J Fox Foundation. Following tremor detection, coin cell vibrators are simulated to reduce tremors. A wearable tremor monitoring bracelet was designed to incorporate 7 parallel-connected vibrators powered by a 3 V battery. For device testing, tremors were simulated using a TENS unit. Lastly, I built an app using Android App Studio to display collected data to patients and clinicians. The Arduino sensor data is transmitted via Bluetooth and stored in Firebase. The TremorSense device met the engineering and design criteria: by weighing under 40g, costing under $40, and successfully differentiating between tremor and non-tremor movements with an accuracy of 92.31%. This tool enables physicians to better monitor and treat PD patients, improving their quality of life.

Mohamed Musa, Sylvania Northview High School
Analyzing the Effects of Treating Cadmium Telluride Solar Cells with Single Walled Carbon Nanotubes
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm
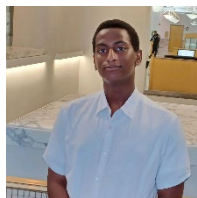
In solar panels, electrons get excited into a higher energy level with the light they capture. The negative charge of the excited electrons and the now empty and positive place they jumped from makes a positive empty hole make an electron pair separated by the forbidden gap, composed of the distance jumped by the electron, making a charge difference. Like two ends of a magnet, the electron-hole pair attracts each other, and the electron travels through an external circuit, part of it on the solar cell, making a circuit, generating energy, and eventually meeting the hole and starting over capturing more light. For the external circuit, the electron has to travel through. Energy is lost because "wires" are resistive, losing some energy to heat; to prevent loss to heat in the "wire", having conductive layers is standard procedure. In Cadmium Telluride (CdTe) photovoltaic cells, transparent conductive oxides (TCOs) are used for one side of the circuit and Copper Chloride ($CuCl_2$) is used as the other side on the positive side. After applying and testing the conductive layer with $CuCl_2$ in tandem with single walled carbon nanotubes (SWCNT) handled in a sodium dodecylbenzenesulfonate (SDBS) solution in various manners, it was found that heating the photovoltaic cells multiple to apply multiple conductive layers on one side is inefficient; although using SWCNT right before applying and heating $CuCl_2$ shows promise, using only $CuCl_2$ as a conductive layer for the positive side.

Reyansh Pardeshi, University School
Designing and Testing a Nichrome Wire Heating Element to Heat a Squash Ball to 35°C
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

Squash balls are a major inconvenience when it comes to playing the sport of squash. Since the balls are made of raw butyl rubber, which is vulcanized to give it a property of imperviousness to moderate heat or cold, when it is cold it doesn't bounce well. This is why many players hit the ball repeatedly against the wall to warm it up. However, this process wastes time and energy. Using a nichrome wire heating element, which converts electrical energy into heat energy, a squash ball is able to be heated up more effectively, saving both time and energy. In this experiment after trying to make the heating element from scratch it was decided to use an old hair dryer, which is also a nichrome wire heating element, and could save money and time. It was then used to heat up the squash balls (which were placed on the element, (n = 3) to 35°C which was compared to the conventional method of hitting the balls against the wall. From the data it was found that the heating element heated the squash balls to 35°C 4.8 times faster than the conventional method, taking only an average of 3.4 minutes compared to the 16.16 minutes. After making improvements to the heating element by adding more insulation and nichrome wire it was found that the heating element heated the squash balls to 35°C 13.5 times faster than the conventional method taking an average of 1.2 minutes (ANOVA test $p = 0.05$).

Manan Raina, Hawkens Upper School
The Burden of Type 2 Diabetes Mellitus vs. Other Chronic Diseases (COPD, IHD, and Stroke) Attributable to Air Pollution across the United States: Analysis of the Global Burden of Disease 1990-2019
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

The escalating prevalence of Type 2 Diabetes Mellitus (T2DM), affecting approximately 33 million individuals in the United States and 366 million worldwide, has become a critical public health concern. This study aims to assess the burden of T2DM in the U.S. attributable to Particulate Matter 2.5 (PM2.5) air pollution over the last 30 years, considering the influence of obesity, social factors, and air pollution. Recent increases in PM2.5, largely due to climate change, highlight the need to evaluate its impact on T2DM incidence. Using data from the Global Burden of Diseases (GBD) 2019 study, which provides comprehensive health loss assessments for 329 diseases across 204 countries, we analyzed the burden of T2DM and other chronic diseases (COPD, IHD, and stroke) linked to air pollution. The study focused on 51 U.S. states (including DC), examining the role of differing PM2.5 sources, particularly household air pollution (HAP) and ambient air pollution (AAP). Socio-demographic index (SDI) disparities, calculated based on economic growth, fertility rate, and educational attainment, were also considered. Our findings reveal significant geographic and SDI-related disparities in the burden of T2DM due to air pollution. The study emphasizes the necessity of targeted interventions to address air pollution and its uneven impact on T2DM across various regions, offering crucial insights for public health policy and preventive strategies.

Bharath Ramanujam, Dublin Jerome High School
Leveraging Machine Learning to Decipher Key Characteristics of Successful NFL Coaches to Identify Characteristics of Great NFL Coaches
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

This study explores the dynamic intersection of machine learning and the realm of professional football coaching, specifically within the National Football League (NFL). There is always an ongoing debate on who, the coach or the quarterback, that contribute the most to the team's victory. The objective of this research is to focus on only the coach and identify and analyze the different characteristics that distinguish successful NFL coaches, ultimately contributing to the triumph of their teams. Leveraging a comprehensive dataset from pro-football reference encompassing coaching histories, team performance metrics a machine learning model was used to understand and discover any patterns and correlations. By using a machine and an unsupervised algorithm like K means it hopes to gain insights into the tenure, strategic decision-making that are key to successful coaching tenures in the NFL. The aim is to highlight what makes a good coach when they are with a certain team. The data set covers 20 years of data from 2002 to 2022 season. To keep the study fairly even only coaches who have at least 5 years of coaching experience over the last 20 season were considered. The intent of this approach, is to provide a data-driven framework for easily and unbiasedly identifying what makes a good coach within the NFL, thereby facilitating a more informed decision-making process for team owners, general managers, and stakeholders. The findings hold the potential to redefine conventional wisdom about coaching success, may be even settling some decade long arguments around some past and emerging dynasties that have come to be.

Varun Ramanujam, Dublin Jerome High School
Statistical Study of Social and Economic Factors Influence on Pollinator Habitat in Ohio
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

This research looks at the complex relationship between social and economic factors and their influence on the decline of pollinator habitats in the state of Ohio. There is a lot of research that explores the impacts of climate change, federal conservation laws and their environmental impacts as independent focus areas. Recognizing the critical role of pollinators in the agricultural economic ecosystem, this study adopts a comprehensive approach by synthesizing data from various sources, like government records, academic studies, and other publicly available sources to look for dependencies and overlaps in social and economic drivers. This study uses statistical tools to see how things like population age, migration, career choices, income levels, land usage, crop prices and federal and state laws might be influencing the places these pollinators have called home. By studying these data points together, the aim is to uncover patterns and insights in these socioeconomic variables that can serve as a guide in making informed decisions to support the well-being of pollinators in Ohio. This analysis strives to highlight the needs for much broader social and economic considerations as a more effective way to addressing pollinator habitat decline in the state of Ohio. The findings of this research not only enhance our understanding of the multifaceted challenges faced by pollinators but also provide valuable insights for policymakers, conservationists, and community leaders in developing targeted strategies for habitat preservation and restoration. Are we heading into a perfect storm of changing demographics and competing Federal and state laws with our eyes open?

Niklas Rietsch, University School
The Role of Neuronal Primary Cilia in Alzheimer's Disease
Oral Presentation: Ruff Memorial Learning Center 07 // 9:55 am
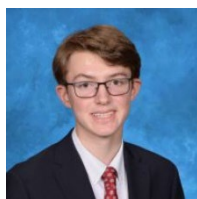
Alzheimer's disease (AD) is the most common form of dementia, accounting for 60-80% of cases in the United States. Despite its prevalence, effective interventions to halt neurodegeneration in AD remain elusive. This study sheds new light on this challenge by highlighting primary cilia—crucial cellular organelles for signaling and autophagy—as a significant focal point in AD pathology. An in-depth analysis of differentially expressed genes (DEGs) in postmortem AD brains identified a substantial number of DEGs associated with primary cilia, a finding that rivals the prevalence of DEGs linked to traditionally implicated organelles like mitochondria. Yet, the exploration of primary cilia in the context of AD is markedly underrepresented in existing literature. Bridging this knowledge gap, the research utilized immunohistochemical staining for adenylate cyclase 3 (AC3) in 5xFAD mouse models, uncovering a pronounced diminution in primary cilia. This reduction predominantly manifests as a shortening of cilia length, correlating with the progression of AD pathology. Parallelly, postmortem human AD brain samples exhibited similar perturbations in primary cilia gene expression, thereby mirroring the findings in mouse models. Intriguingly, the observed disruption of primary cilia in the Dentate Gyrus suggests a ciliopathy-like mechanism at play in AD pathogenesis. These insights not only spotlight an overlooked dimension in AD research but also propose a novel and potentially groundbreaking perspective on its underlying mechanisms, potentially paving the way for novel therapeutic avenues.

Ali Sediqe, Ottawa Hills High School
The Effects of Aging on 10 Genes in Zebrafish
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

Aging is a process every creature on the planet undergoes. Much of it is known from a phenotype perspective. Yet, the extent to which we know about aging on a genomic level solely consists of the fact that telomeres shorten with age and are aging indicators on a cellular level. Little research has been done into the effects of aging on specific genes of interest. I looked at signs of aging in ten genes in the gastrointestinal tract, heart, and brain of 2-year-old zebrafish, comparing it to those genes in 5-day-old zebrafish. A TRIzol reagent was used to isolate the RNA of the fish and it was mixed with primers and SYBR Green Master Mix before being placed in the qPCR. Using a statistical analysis of ΔCt, $\Delta\Delta Ct$, and $-2^{\Delta\Delta Ct}$, we found that there was no statistically significant difference between the amount of gene expression in the gastrointestinal tract and heart versus the 5-day-old fish for every gene study. There was a statistically significant difference between the gene expression in the brain and the 5-day-old fish for every gene studied. We can infer from this that the brain ages at a much faster rate than other parts of the body. The next step from here is to see what this means in a holistic sense and how these specific genes manifest themselves in the different organs to affect the body.

Anshul Sharma, University School
The Impact of Social Vulnerability Index Changes on Overall and Race-Specific Prostate Cancer One-Year Survival Over a 20 Year Period (2000-2020)
Oral Presentation: Ruff Memorial Learning Center 102 // 11:10 am

The CDC's Social Vulnerability Index (SVI) measures an individual's health vulnerability based on geographic location and environment. Previous studies have linked SVI at the time of diagnosis to cancer incidence and mortality rates. Here, the change in county-specific SVI values and their impact on the change in one-year prostate cancer (PrCa) survival rates were investigated. This was done for the overall population and by self-reported race from 2000-2020. SVI county-level data and Surveillance, Epidemiology, and End Results (SEER) data that met our eligibility requirements were kept and then were analyzed using chi-squared tests through R 4.3.1. Out of 1,006 SEER counties, 444 were eligible for the overall analysis, 397 for White PrCa cases, and 97 for Black PrCa cases. Most significantly, our novel study established positively correlated associations between SVI changes and one-year PrCa survival among the overall and White PrCa cases, which disproves the original hypothesis. Still, this study illustrated the necessity of looking at correlation through a change of time because it established a threshold for an SVI and PrCa survival rate correlation, which previous research hadn't found. Further research is needed to generalize these findings to other cancers, stages of disease, and racial groups.

Gavin Sheppard, University School
Predicting WAR (Wins-Above-Replacement) in Major League Baseball
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm
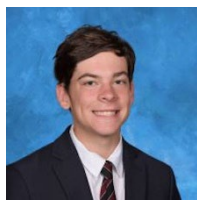
Using statistical analysis in sports was not always seen as useful until Bill James popularized data analysis through Sabermetrics. Sabermetrics used statistical models to find deeper meanings among traditional baseball stats that correlated to player performances. The primary objective of this research project is to develop a predictive model for a pitcher's performance in a given year (WAR) based on historical data, such as pitching statistics from previous seasons. Wins Above Replacement (WAR) stands as a fundamental baseball statistic, serving to quantify a player's contribution in comparison to a replacement-level player. The roots of today's WAR can be directly traced back to Keith Woolner's concept of VORP (Value Over Replacement Player), which debuted in the 1990s for Baseball Prospectus and was probably the first statistic to measure a player's value. WAR measures the extra wins a player brings to their team throughout a season, surpassing the performance of a readily available replacement player usually acquired at the league minimum salary. This model will assist in making informed decisions related to player development, scouting, and team strategy. The machine learning model uses supervised learning with a training dataset consisting of historical baseball statistics and a testing dataset defining the parameters of future MLB games. The LASSO linear regression model yielded a mean squared error of 0.66, a root mean squared error of 0.81, and an r-squared value of 0.45. Future research will explore other regression algorithms as well as predict different positions to expand the model's capabilities.

Bryan Shin, Solon High School
Rational Design and Testing of Natural Hemostatic Hydrogel Using Plant Materials
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm
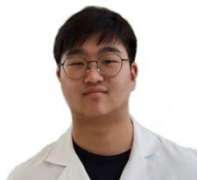
Bleeding resulting from trauma or surgical procedures, including gunshot wounds, represents a critical health issue, with uncontrolled bleeding often culminating in patient death. Therefore, the development of safe, effective, and convenient hemostatic agents is of paramount importance in securing the "Golden time" to save patients' lives. Hemostatic agents are manufactured in various forms tailored for wound healing purposes depending on the active ingredients used, and these formulations include nanofibers, gels, sponges, and nanoparticles. In the context of extensive prior research, Aloe vera-based hydrogels, characterized by flexible strength and high functionality, have emerged as a promising platform for wound applications due to their unique biocompatibility features. This study provides our comprehensive research findings on the application of Aloe vera-based hydrogels as hemostatic agents. Furthermore, we extensively explore the methodology of using Aloe vera-based hydrogels for therapeutic delivery at wound sites by incorporating various antimicrobial agents, extending their utility beyond hemostasis. Our research offers valuable insights into the utilization and broader applications of Aloe vera-based hydrogels as hemostatic agents, emphasizing their potential to enhance hemorrhage control in various emergency scenarios.

Anna Spohler, Global Impact STEM Academy
Different Clay Filtration Systems
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

The purpose of conducting this experiment was to examine how different filters would filter contaminated water. More specifically, what combination of activated charcoal and copper sponges would have the best results. There has been a variety of research done over the effects of different combinations of filters, especially because of the water crisis currently going on all over the world. The hypothesis was, if contaminated water is filtered through a combination of the following: activated charcoal, a copper sponge, and both, then the clay pot with both activated charcoal and a copper sponge will have the best results. Most of the other studies on this topic use silver as the chosen metal for filtration, while in this case, it is copper. This is because people in third world countries are more able to get access to copper, and it is more cost effective. The hypothesis was tested by making contaminated water using Escherichia coli, rural soil and miracle-gro. Escherichia coli is one of the commonly used bacteria in experiments because it is safe to use without fear of an outbreak, and rural soil and miracle-gro were added to replicate the water in developing countries. Three different combinations were tested. Both activated charcoal and the copper sponge, just a copper sponge, and just activated charcoal. There was, of course, also a control sample. 100 mL of water was filtered through the different filters. In total, five different tests were completed. These tests included the pH, Turbidity, Nitrate, Nitrite, and an E. coli count. The results of this study supported previous studies as well as the hypothesis of this one. The water filtered through both activated charcoal and the copper sponge had the best results of the different tests conducted.

Nandita Srikumar, Solon High School
Effect of Curcumin and Epigallocatechin-3 Gallate on the Interaction Between CRMP-2, Tau, and CDK5 in Alzheimer's Disease
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

Alzheimer's disease is a fatal disorder that is characterized by the aggregation of the Tau protein into neurofibrillary tangles and by hyperphosphorylation of the collapsin response mediator protein (CRMP-2) by the cyclin-dependent kinase-5 (CDK5) protein. To prevent this aggregation, which is a key factor for brain degradation, epigallocatechin-3 gallate (EGCG), a catechin found in green tea, and curcumin, found in turmeric, have shown promising results. To examine their effects on key Alzheimer's proteins, first, the relationship between CRMP-2, CDK5, and Tau, was confirmed in a series of baseline tests which were established using microscale thermophoresis (MST) to compare the binding of two proteins at a time. Using these baselines, additional binding experiments were conducted with all three proteins, and both curcumin and EGCG were added in different combinations to gain a better understanding of the interaction of these proteins and molecules at a molecular level. The results indicated that both compounds had an effect on the binding between the three proteins with the EGCG decreasing binding and the curcumin increasing the binding.

William Stephans, University School
Interactions between BRAF-mutated and Wild-type Lung Cancer at Varying Doses of Target Drug
Oral Presentation: Ruff Memorial Learning Center 102 // 10:45 am

This study investigates the application of game theory to optimize treatment strategies for non-small cell lung cancer (NSCLC) with a focus on the BRAF gene mutation. Recognizing the Hallmarks of Cancer, including sustained proliferation and resistance to growth inhibitors, the research aims to identify effective therapeutic interventions by modeling the competitive dynamics between BRAF-mutated and wild-type lung cancer cells and various chemotherapeutic drugs. Preliminary results indicate the expected responses of cells to drugs, with nuanced interactions observed in a game assay. While BRAF cells exhibit higher fitness at elevated drug concentrations, competitive exclusion is observed at lower concentrations. The findings suggest that a uniform high drug dose may not be optimal, emphasizing the need for personalized treatment strategies to enhance the treatability of NSCLC by favoring competitive exclusion at lower drug concentrations. In conclusion, integrating game theory into cancer treatment strategies offers insights into dynamic cell-drug interactions, contributing to the development of more effective and personalized therapeutic approaches for NSCLC with BRAF mutations.

Elizabeth Theobald, Archbold High School
Trihalomethane Occurrence and Formation within Water Distribution Systems Impacting Public Schools
Oral Presentation: Ruff Memorial Learning Center 103 // 9:55 am

Trihalomethanes (THM) are cancer group B, EPA-regulated disinfectant byproducts of chlorine-treated water. Fulton County, OH public school districts supplied by surface water containing high levels of organic compounds were surveyed. It was hypothesized that school THM levels could be predicted by Consumer Confidence Reports (CCR), and timed runs of tap water following periods of nonuse would decrease THMs. Increased water temperature and time were hypothesized to cause rising THM and decreasing chlorine levels with copper and PEX-C materials not significantly impacting THMs. Sixty-six point-of-use water samples were collected from schools representing eight districts. Thirty-six additional samples evaluated the effects of temperature, time and materials in the water distribution systems (WDS). Temperature, free and total chlorine using the Hach colorimeter DPD method, and THM levels using the Parker THM Analyzer employing purge-and-trap gas chromatography were measured. Results indicate CCRs can predict school THM levels. Timed tap water runs were an ineffective measure to reduce THMs. Increased distance of schools from the source water correlated with rising THMs. Increased temperature led to increased TTHM ($p = 0.0108$), chloroform ($p = 0.0010$), and bromoform ($p = 0.0009$) with decreased free ($p = 0.0033$) and total chlorine ($p = 0.0025$). Over time, chlorine decayed in all samples. Water held at 5°C and 50°C demonstrated rising THM levels in the initial 48 hours. Thereafter, THMs decreased in the 50°C samples and continued to rise in the 5°C samples. By identifying these WDS characteristics and schools benefiting from mitigation strategies, student lifetime exposure can be minimized.

Christopher Thompson, Ottawa Hills High School
The Dynamics of Aces: A Mathematical Analysis of the Tennis Serve
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

This research paper explores the geometrical aspects of tennis ball trajectories. I propose two mathematical models to describe tennis ball trajectories: linear models for trajectories devoid of the influence of gravity and quadratic models accounting for gravitational effects. In the context of linear models, I establish the functional relationship between the serving angle and the distance the ball covers post-net crossing. Furthermore, I derive the maximum and minimum angles based on the dimensions of the court. For quadratic models, I obtain the conditions for the equation to yield real roots and derive the formulas for computing serving angles for given specific values for velocity and serving height. The practical applications of the derived formulas are exemplified through calculated results across various velocities and serving heights. This research aims to provoke interest in mathematics and contribute valuable insights into the intricate dynamics of the tennis serve.

Nina Van Zandweghe, Solon High School
Using Bidirectional Transformer Neural Networks for Advancing Gender Bias Recognition in STEM Job Advertisements
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

Gender disparity persists in most STEM fields, where men vastly outnumber women. Recent research shows that gendered wording in advertisements for STEM jobs may have a significant influence on the appeal of a job to potential female applicants. To increase awareness and potentially address such gender bias in STEM job ads, it is important to recognize the bias as clearly and accurately as possible. Previous research has attempted to predict gender bias in STEM job ads by using a simple word-counting and summation approach. This paper uses a novel machine learning tool that utilizes transformer neural networks to gain a deeper semantic understanding of a job advertisement's language and applies it to a large dataset of STEM job ads. The analysis yields two main results. First, the ads are biased toward masculine language, in line with the findings of previous research. Second, the machine learning approach predicts gender bias in STEM job ads with high accuracy and is able to outperform the word-counting and summation approach.

Ritika Varghese, Sylvania Northview High School
Light-Mediated Difunctionalization of Alkenes for Drug Development
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

Globally, the price of medicine continues to rise every day, as the price of reactants continues to grow in parallel. In order to combat this issue, one must start at the root of the problem: the cost of materials. Inexpensive starting materials such as alkenes, a byproduct from natural oil processing, are an ideal cheaper reagent alternative for drug manufacturing. An inexpensive alkene, such as styrene, can be purchased for as little as six cents per milliliter, which makes it perfect for trying to optimize a reaction pathway since it is inexpensive.

Aaron Velez, University School
Effects of Deep Brain Stimulation and Task Difficulty on Visual Search Performance in Parkinson's
Oral Presentation: Ruff Memorial Learning Center 07 // 9:30 am

The purpose of this experiment is to identify if there are any visual search deficiencies in Parkinson's disease (PD) patients depending on the activations of Deep Brain Stimulation (DBS) and task difficulty. PD results from loss of dopaminergic neurons in the basal ganglia, leading to motor, visual, and cognitive skill deficits, which theoretically increase visual search difficulty (Archibald et al., 2013; Terao et al., 2013). DBS would theoretically aid with these deficiencies relating to visual search. Data was collected from 10 participants who all had DBS and PD (n = 10). They had to find an object (the signal) among a randomized number of noise (extra distracting particles) in two different visual search paradigms (DP1 and DP2). Patients performed both paradigms with DBS on and off. The experiment was designed to have four groups, where the patients performed the visual search for the same task under different conditions (DP1, DP2; DBS ON, DBS OFF). DP1 was designed to be easier than DP2, and it was hypothesized that patients would have a more difficult time finding the signal when there was a larger amount of noise and while performing DP2 because of the increased difficulty, and when DBS was turned off. These findings do not support the hypothesis as there was no statistically significant difference between any of the group's visual search performance, recorded through search time and number of failed trials. However, this experiment is only the first step in learning more about visual search in PD.

Alexander Vincenti, University School
Analyzing the Mechanisms by Which Differentiated Glioma Cells Interact with Glioma Stem Cells and Platelets in the Tumor Microenvironment of Glioblastoma Multiforme
Oral Presentation: Ruff Memorial Learning Center 102 // 10:20 am
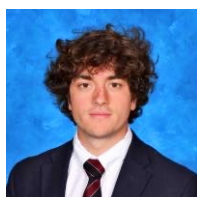
Glioblastoma (GBM) is the most common primary malignant brain tumor in adults. Classified as a grade IV glioma, GBM is one of the deadliest forms of cancer. GBM remains incurable and median survival of GBM patients is 10-12 with a 5-year survival rate of just 5.7%. It is well established that the high mortality rate and treatment resistance in GBM is due to a population of stem-like cells known as glioma stem cells (GSCs). GSCs have the ability to self-renew and proliferate at high rates to cause a recurrence in the tumor. In addition to their phenotypes, GSCs colocalize in necrotic and perivascular regions of GBM tissue, regions with high platelet counts. My laboratory has previously shown that a bidirectional relationship between platelets and GSCs in the tumor microenvironment enhances GBM oncogenesis, with the coagulation protein thrombin being the main driver of this interaction. GSCs also differentiate, a process wildly overlooked in modern cancer studies. By testing GSC proliferation with respect to DGCs, platelets, and DGCs and platelets together, it was found that DGCs significantly (ANOVA; $p \leq 0.001$) enhanced GSC proliferation. Next, solely DGCs were introduced to platelets and the results suggested that DGCs significantly (*ANOVA*; $p \leq 0.01$) enhance platelets compared to GSCs. Lastly, I found that DGCs secret significantly (t-test; $p \leq 0.001$ for Mes20 and 1959 Cell Lines, $p \leq 0.05$ for 3565 cell Line) more thrombin than GSCs, suggesting novel information that DGCs may play a larger role in disease progression than previously thought.

Ryan Wang, University School
Development of Persistent DNA Vectors for Safe and Lasting Non-viral Gene Therapies
Oral Presentation: Ruff Memorial Learning Center 102 // 9:55 am
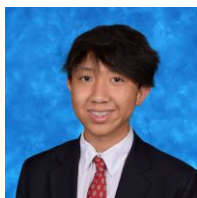
Scaffold/MatrixAttachment Regions (S/MARs) are specific regions of DNA that help to stabilize chromatin structure and regulate gene expression by facilitating interactions between DNA and the nuclear matrix. Non-viral plasmid vectors used for gene therapy have severe limitations such as short-term cargo gene expression due to rapid loss of the plasmid DNA in the cell. The objective of this project was to develop a non-viral plasmid vector that is able to persist and replicate at high levels to combat the short gene expression from rapid loss and silencing of plasmid DNA. It was hypothesized that inserting S/MARs into proTLx-K plasmids would cause the GFP and luciferase reporter genes in the plasmid to persist and replicate at a higher level. The project used subcloning to insert an N-DISar2 S/MAR element into a proTLx-K plasmid that contained GFP and luciferase reporter genes. The resulting plasmid was transfected into M17 cells which had GFP and luciferase intensity measured at intervals of every 5 cell passage. The cells transfected with the S/MARs proTLx-K plasmids were compared to a control group of cells transfected with proTLx-K plasmids that didn't contain any S/MARs elements. From passage 5 to passage 10, the GFP expression from the cell with a S/MAR containing plasmid increased by 104 RLU while the cell without a S/MAR decreased by 4322 RLU. S/MAR elements aided plasmids in tethering to and entering the nucleus, to transcribe and replicate the genes at higher levels.

Weining Wang, University School
Artificial Evolution of Hydrogenase Using Gaming GPUs
Oral Presentation: Ruff Memorial Learning Center 103 // 10:20 am

The optimization of hydrogenase enzymes for biological hydrogen production has gained attention for its eco-friendliness and cost-effectiveness. With the increasing role of hydrogen as a sustainable energy carrier, efficient hydrogenase enzymes are vital for applications ranging from vehicle power to renewable energy grid stabilization. Current hydrogen production predominantly relies on methods like electrolysis, which, though effective, are less efficient compared to emerging technologies that enable direct conversion of sunlight into hydrogen. The key to addressing this problem is to have a much higher efficiency enzyme–hydrogenase. My hypothesis is that varying sequences for specific amino acid residues along the hydrogenase proton transfer pathway can generate protein structures with enhanced efficiency and reduced dependency on water molecules for proton transfer. This research project outlines a novel computational design involving enumerating sequences between key residues, using Python code for generating protein sequences for subsequent structure prediction through AI-based tools like AlphaFold II. This approach aims to discover protein sequences that can maintain the local geometry essential for efficient proton transfer. The significance of this research lies in its potential to provide a blueprint for future *in silico* experiments using AI technology to evolve protein functions artificially. The anticipated outcomes not only promise advancements in biological hydrogen production but also set a foundation for future experimental validation in wet labs. This research represents a crucial step towards making biological hydrogen production more efficient and scalable, thereby contributing significantly to the development of sustainable energy solutions.

William Wang, Orange High School
Association of Semaglutide with Risk of Suicidal Ideation in a Real-world Cohort
Oral Presentation: Ruff Memorial Learning Center 103 // 10:45 am
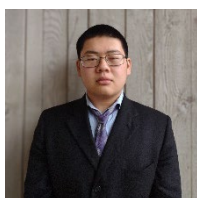
Concerns over reports of suicidal ideation associated with semaglutide (Wegovy or Ozempic) treatment, a glucagon-like peptide 1 receptor (GLP1R) agonist medication for type 2 diabetes (T2DM) and obesity, have led to investigations by European regulatory agencies. In this retrospective cohort study of electronic health records from the TriNetX Analytics Network, we aimed to assess the associations of semaglutide with suicidal ideation compared to non-GLP1R agonist anti-obesity or anti-diabetes medications. The hazard ratios (HRs) and 95% confidence intervals (CIs) of incident and recurrent suicidal ideation were calculated for the 6-month follow-up by comparing propensity score-matched patient groups. The study population included 240,618 patients with overweight or obesity who were prescribed semaglutide or non-GLP1R agonist anti-obesity medications, with the findings replicated in 1,589,855 patients with T2DM. In patients with overweight or obesity (mean age 50.1 years, 72.6% female), semaglutide compared with non-GLP1R agonist anti-obesity medications was associated with lower risk for incident (HR = 0.27, 95% CI = 0.200.32–0.600.36) and recurrent (HR = 0.44, 95% CI = 0.32–0.60) suicidal ideation, consistent across sex, age, and ethnicity stratification. Similar findings were replicated in patients with T2DM (mean age 57.5 years, 49.2% female). Our findings do not support higher risks of suicidal ideation with semaglutide compared with non-GLP1R agonist anti-obesity or anti-diabetes medications.

Clarisse Wee, Hathaway Brown School
Location of and Changes in HIF1a Expression in the Retinas of Retinoic Acid Signaling-Inhibited Zebrafish
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

During diabetic retinopathy, a condition that can stem from diabetes mellitus, the blood-retinal barrier (BRB) can break down. BRB breakdown has also been observed when retinoic acid (RA) signaling is inhibited. Preliminary data suggests that many pathways, including the Hypoxia Inducible Factor 1 Alpha (HIF1α) pathway, experiences changes when RA signaling is inhibited. To explore this and its possible effect on BRB breakdown, zebrafish (*Danio rerio*) were treated with either varying amounts of 4-diethylaminobenzaldehyde (DEAB) to inhibit RA signaling or 0.004% dimethyl sulfoxide (DMSO) to serve as a control. Then, whole mounts of the retinas from the zebrafish were taken and immunofluorescence staining was performed. Western blots were also conducted using zebrafish whole retina lysates. Stainings reveal the presence of HIF1α signaling in photoreceptors in the outer nuclear layer, as well as in the ganglion cell layer and outer plexiform layer. We are studying with RA inhibition to study BRB breakdown alone. Then, when we find out which pathways are involved in BRB breakdown, we can apply this knowledge to develop potential treatments for BRB breakdown in DR.

Margaret Wheeler, Hilltop High School
The Strength of a Zig-Zag Stitch on Different Thread and Fabric Types - A Two Year Study
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

The purpose of this experiment was to provide sewers with the necessary information to make an informed decision on what type of fabric and thread to use, in order to hold either the seam or the fabric with the most amount of force. It was hypothesized that nylon fabric would hold the most amount of force, and the polyester thread would hold the most amount of force. Six fabric types were tested: cotton, polyester, silk, polycotton, linen, and nylon. Five thread types were tested: cotton, polyester, silk, polycotton, and nylon. These 30 combinations were each tested on fabric samples. Five samples of each type were then clamped horizontally into the ME-8236 Materials Testing Apparatus, and pulled apart by the machine until the first stitch broke, or the fabric tore. The significance of the results was determined by an unpaired t-test. The first hypothesis, about fabric types, was supported. Nylon fabric held 34 pounds of seam strength, while linen held 34 pounds, cotton held 32 pounds, silk held 31 pounds, polyester held 30 pounds, and polycotton held 28. When nylon fabric was compared to the rest of the fabric types, its seam strength difference was not statistically significant. Additionally, nylon fabric held 80 pounds of force before the fabric tore, cotton held 54 pounds, linen held 45 pounds, polycotton held 39 pounds, polyester held 37 pounds, and silk held 33 pounds. When nylon fabric strength was compared to the other fabrics its difference was statistically significant ($p < 0.0001$ to $p = 0.0049$). The second hypothesis, about thread types, was not supported. Nylon thread held 57 pounds of seam strength, polycotton held 35 pounds, polyester held 33 pounds, silk held 30 pounds, and cotton held 28 pounds. When nylon thread was compared to the rest of the thread types, it was found to be statistically significant ($p < 0.0001$ to $p = 0.0033$). Nylon thread also had the highest seam efficiency, at 93%.

Gordon Zeitz, University School
Improving the Efficiency of Small Scale Hydropower by Modifying the Turbine Shape
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm
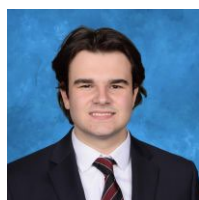
Hydroelectric power is the largest source of sustainable energy used on this planet, and while large scale power plants are extremely efficient small-scale hydropower is not very efficient. But if the efficiency of small-scale hydropower could be increased it would allow for small communities with limited access to the power grid to have more consistent access to power. To allow for this to happen more efficient turbines must be developed. With the goal of designing and testing turbines that are more efficient that the modern standard I designed a plexiglass testing rig that I could swap different turbines in and out of to test their efficiencies under the same flow conditions. Initially this rig would utilize water flowing along the box to test the turbines, but I shifted to instead having the turbines catch water flowing off a ledge in the box. After obtaining the data from each of the turbines they were less efficient than the modern standard likely due to inefficiencies in the rig itself. Even with that shortcoming I was able to test the different turbines against each other and found the most efficient turbine shape that I designed was the angled turbine with angled blades. This information can be used to allow for future tests to have a direction to develop in with iterations of blade designs.

Jennifer Zhang, Hathaway Brown School
The Spread and Regional Characteristics of Covid-19: Evidence from Social Media
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

This study examined the relationship between the spread and regional characteristics of Covid-19 during 2020 to 2022 in the U.S. I found that Covid-19 spread faster in counties with larger populations and higher income per capita. In particular, the findings showed that regions with high social connectedness measured by online Facebook friends experienced lower levels of Covd-19 spread. The results suggest that social connectedness was helpful in mitigating disease spreading.

Oral Judging Rubric (2023-2024)

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 4-5	Satisfactory 2-3	Needs Improvement 0-1	Points Possible
Identification of Research Problem	• The presenter clearly demonstrates a thorough understanding of existing knowledge about the research problem. • The research problem is clearly stated and explained in detail.	• The presenter demonstrates some existing knowledge about the research problem. • The problem is stated but lacks detailed explanation.	• The presenter demonstrates little existing knowledge about the research problem. • Statement of the problem us unclear and explanation is sparse.	5
Scientific Thought	• There is balanced presentation of relevant and legitimate information and data to support the research problem. • The presenter shows thoughtful, in-depth analysis of the topic.	• The information presented supports a central purpose or argument at times. • Analysis of the topic is basic or general.	• The central purpose is not clearly defined. • Analysis is vague or not evident.	5
Creativity/Originality	• The presenter fully demonstrates their individual contributions to the project.	• The presenter only partially demonstrates their individual contributions to the project.	• The presenter does not acknowledge their individual contributions to the project.	5
Acknowledgements	• Acknowledges major assistance received and credits anyone who helped with the project and describes in detail how they helped.	• Acknowledges major assistance received and credits anyone who helped with the project.	• Does not acknowledge major assistance received or credit those who helped.	5
Research Design	**Science:** • Description of research design and procedures is detailed and shows reproducibility. • Control and variables are clearly identified and explained. **Engineering, computer science, technology:** • Clear, detailed description and recognition of relationship between design and end product. • Addresses economic feasibility of solution. • Solution is tested for performance under conditions of use.	**Science:** • Description of research design and procedures lacks some detail but shows reproducibility. • Control and variables are identified but may not be thoroughly explained. **Engineering, computer science, technology:** • Description and recognition of relationship between design and end product. • Partially addresses economic feasibility of solution. • Solution is tested for performance under conditions of use.	**Science:** • Description of research design and procedures lacks detail and does not show reproducibility. • Control and variables are poorly identified. **Engineering, computer science, technology:** • Very little description and recognition of relationship between design and end product. • Does not address economic feasibility of solution. • Solution is not tested for performance under conditions of use.	15
Methods	• Encompasses all materials required. • Clearly states the hypothesis/research questions and explains the study design. • If used, statistical procedures are included. • A detailed narration of the steps taken to complete the experiment is included.	• Encompasses most materials required. • States the hypothesis/research questions and explains the study design. • The statistical procedures are included but are unclear. • A narration of the steps taken to complete the experiment is included but may lack detail.	• Does not encompass all materials required for the research. • Hypothesis/research questions are not stated. • The statistical procedures are not included. • Steps taken to complete the experiment are listed but are unclear.	15
Results	• Results of the research are summarized. • Data trends are clearly addressed and analyzed. • Data that can stand alone in tables/figures are included in the paper or appendix.	• Results of the research are partially summarized. • Identification and analysis of data trends is vague. • Data that can stand alone in the form of tables/figures are sometimes included.	• Results of the research are poorly summarized. • Data trends are not addressed. • Data is not appropriately represented in tables/figures.	15

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

Poster Judging Rubric (2023-2024)

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 4-5	Satisfactory 2-3	Needs Improvement 0-1	Points Possible
All posters must include: • **Title** • **Hypothesis or Engineering Design** • **Methods and Procedures** • **Data Analysis** • **Results/Conclusion** • **Bibliography/References** **Acknowledgements (may be included, not required)**	• Poster includes all required elements.	• Poster includes around half of the required elements.	• Poster includes few or none of the required elements.	15
Visual Presentation	• Overall visually appealing; not cluttered; colors and patterns enhance readability • Uses font sizes/variations which facilitate the organization, presentation, and readability of the research. • Graphics (e.g., tables, figures, etc.) are engaging and enhance the text. • Content is clearly arranged so that the viewer can understand order without narration.	• Visual appeal is adequate; somewhat cluttered; colors and patterns detract from readability. • Use of font sizes/variations to facilitate the organization, presentation, and readability of the research is somewhat inconsistent/distracting. • Graphics (e.g., tables, figures, etc.) adequately enhance the text. • Content arrangement is somewhat confusing and does not adequately assist the viewer in understanding order without narration.	• Not very visually appealing; cluttered; colors and patterns hinder readability. • Use of font sizes/variations to facilitate the organization, presentation, and readability of the research is inconsistent/distracting. • Graphics (e.g., tables, figures, etc.) do not enhance the text. • Content arrangement is somewhat confusing and does not adequately assist the viewer in understanding order without narration.	15
Statement of Research Problem	• The presenter clearly demonstrates a thorough understanding of existing knowledge about the research problem. • The research problem is clearly stated and explained in detail.	• The presenter demonstrates some existing knowledge about the research problem. • The problem is stated but lacks detailed explanation.	• The presenter demonstrates little existing knowledge about the research problem. • Statement of the problem is unclear and explanation is sparse.	5
Scientific Thought, Creativity, Originality	• The presenter fully demonstrates their individual contributions to the project. • There is balanced presentation of relevant and legitimate information and data to support the research problem. • The presenter shows thoughtful, in-depth analysis of the topic.	• The presenter only partially demonstrates their individual contributions to the project. • The information presented supports a central purpose or argument at times. • Analysis of the topic is basic or general.	• The presenter does not acknowledge their individual contributions to the project. • The central purpose is not clearly defined. • Analysis is vague or not evident.	5
Methods	• Encompasses all materials required, states the hypothesis/research questions and explains the study design. • If used, statistical procedures are included. • A narration of the steps taken to complete the experiment is included.	• Encompasses all materials required, states the hypothesis /research questions and explains the study design. • The statistical procedures are included but are unclear. • A narration of the steps taken to complete the experiment is included.	• Does not encompass all materials required for the research and hypothesis/research questions are not stated. • The statistical procedures are not included. • Steps taken to complete the experiment are listed.	10

Criteria	Excellent 4-5	Satisfactory 2-3	Needs Improvement 0-1	Points Possible
Research Design	**Science:** • Description of research design and procedures is detailed and shows reproducibility. • Control and variables are clearly identified and explained. **Engineering, computer science, technology:** • Clear, detailed description and recognition of relationship between design and end product. • Addresses economic feasibility of solution. • Solution is tested for performance under conditions of use.	**Science:** • Description of research design and procedures lacks some detail but shows reproducibility. • Control and variables are identified but may not be thoroughly explained. **Engineering, computer science, technology:** • Description and recognition of relationship between design and end product. • Partially addresses economic feasibility of solution. • Solution is tested for performance under conditions of use.	**Science:** • Description of research design and procedures lacks detail and does not show reproducibility. • Control and variables are poorly identified. **Engineering, computer science, technology:** • Very little description and recognition of relationship between design and end product. • Does not address economic feasibility of solution. • Solution is not tested for performance under conditions of use.	10
Results	• Results of the research are summarized. • Data trends are clearly addressed and analyzed. • Data that can stand alone in tables/figures are included in the paper or appendix.	• Results of the research are partially summarized. • Identification and analysis of data trends is vague. • Data that can stand alone in the form of tables/figures are sometimes included.	• Results of the research are poorly summarized. • Data trends are not addressed. • Data is not appropriately represented in tables/figures.	10
Discussion & Conclusions	• Conclusion is logical and relevant to the research problem and results of experimentation or testing. • Discussion addresses the significance of the results in detail, as well as recognizes the limits of the research. • Practical and/or theoretical implications of the research are recognized.	• Conclusion may rely on unsound reasoning and does not fully address its relevance. • Discussion addresses the significance of results but lacks detail and/or only partially addresses the limits of the research. • Practical and/or theoretical implications of the research are recognized.	• Conclusions are not based on results and/or do not tie into the research problem or the relevance of results. • The significance of the results is barely discussed, and the limits of the research are not addressed. • Discussion does not recognize the practical and/or theoretical implications of the project.	15
Communication	• Student is able to clearly communicate research results to non-specialized audience members and judges. • Student defines terms as needed and avoids overuse of technical jargon. • Responses to questions from judges and audience are thoughtful and appropriate.	• Student is able to communicate research results to judges but may not be able to reach non-specialized audience members. • Student defines terms sometimes but uses technical jargon. • Responses to questions from judges and audience are thoughtful and appropriate.	• Student is not able to communicate research results clearly. • Student is not able to avoid jargon or define terms used. • Student struggles to answer questions from judges and audience members.	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 2024 National JSHS held May 1-4, 2024

2nd Place Winner: $1,500 College Scholarship sponsored by the United States Army, Navy, and Air Force
Presents research paper at the 2024 National JSHS held May 1-4, 2024

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 2024 National JSHS held May 1-4, 2024

4th Place Winner
Presents poster at the 2024 National JSHS held May 1-4, 2024

5th Place Winner
Presents poster at the 2024 National JSHS held May 1-4, 2024

Ohio JSHS Award for Best Poster Presentation
Certificate for Best Poster Presentation

Congratulations to the 2023 Winners!

1st Place	Sahar Maleki, Hathaway Brown School
2nd Place	Bryn Morgan, West Geauga High School
3rd Place	Srestha Chattopadhyay, Sylvania Northview High School
4th Place	Justice Arai, University School
5th Place	Bowen Jiang, Western Reserve Academy
Alternate Going to Nationals	Michael Zhu, University School
Best Poster Winner	Ishita Kopparapu, Hathaway Brown School

Previous Ohio Student Paper Presenters to the National JSHS

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
2014	Bluyé DeMessie, William Mason High School	Aditya Jog, William Mason High School

Capital University

The Colonel George F. Leist Distinguished Teacher Award

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

2024 Awardee

Cristin Hagans is in her 33rd year teaching science at Hilltop High School. She mentors her students with their science fair projects and strives to provide experiences for rural students to conduct research investigations that allow them opportunities to achieve success and to open possibilities for their future. An alumna of the Society for Science from her high school days participating at the International Science and Engineering Fair, she has served on the council for the NWOSEF regional fair throughout her teaching career and has been privileged to go back to ISEF chaperoning students. Mrs. Hagans coaches volleyball and is the National Honor Society advisor where she inspires people to always do their best and give back to their community through volunteerism. In the summer she teaches at B-Wiser (Buckeye Women in Science and Engineering Research)- a state-wide camp for junior high girls, catches up on reading, and enjoys being on outside adventures with her family.

Cumulative Record of the Colonel George F. Leist Distinguished Teacher Award

Year	Awardee
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
2014	Blythe Tipping, Sylvania Southview High School

Contributing Agencies and Organizations

INDEX OF STUDENT NAMES

SYMPOSIUM EVALUATION

Please, remember to complete the online evaluation for the 2024 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!