

The 59th Annual Ohio Junior Science and Humanities Symposium

Ask.
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University

Columbus, Ohio • March 4, 2022

JSHS
JUNIOR SCIENCE AND
HUMANITIES SYMPOSIUM



*In cooperation with National Science Teaching Association (NSTA) and
with the support of the United States Departments of the Army, Navy,
and Air Force.*

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WELCOME FROM CAPITAL UNIVERSITY'S PROVOST

It is my privilege to welcome you to the 59th 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 April 20-23, 2022, as an in person competition in Albuquerque, NM.

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 personally welcome you to Capital University for the 59th 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 pursue 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 you have already brought so far.

The JSHS program was founded by an 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 59th in 2022, the Ohio Junior Science and Humanities Symposium continues to promote high standards, 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 – 9:20 am	Poster Drop Off	Capital Center Field House
	Registration and Continental Breakfast	Mees Hall Lobby
9:30 – 10:20 am	Welcome and Keynote Address, Dr. Kathryn Sullivan	Mees Auditorium
10:30 – 11:50 am	Student Poster Session	Capital Center Field House
12:00 – 12:50 pm	Lunch	Capital Center Field House
1:00 – 1:50 pm	Career Panel	Capital Center Field House
2:00 – 4:30 pm	Student Oral Presentations	Blackmore Library and Troutman Hall Classrooms

KEYNOTE ADDRESS

Dr. Kathryn Sullivan // Mees Auditorium // 9:30 am – 10:20 am



We are honored to have Dr. Kathryn Sullivan as the Ohio Junior Science and Humanities Keynote Symposium speaker. She is a distinguished scientist, astronaut and government executive. She was one of the first six women to join the NASA astronaut corps in 1978 and holds the distinction of being the first American woman to walk in space. Her submersible dive to the Challenger Deep in June of 2020 made her a triple Guinness World Record holder, as the most vertical person in the world, the first person to both orbit the planet and reach its deepest point, and the first woman to dive to full ocean depth. Dr. Sullivan has held Presidential appointments to the National Science Board and as Chief Scientist, Deputy Administrator and Administrator of the National Oceanic and Atmospheric Administration (NOAA).

Dr. Sullivan earned a Bachelor of Science degree in Earth Sciences from University of California at Santa Cruz and a Ph.D. in Geology from Dalhousie University, Nova Scotia. Dr. Sullivan is a member of the National Academy of Engineering, the American Academy of Arts and Sciences and the National Academy of Public Administration. She has been inducted into the Astronaut Hall of Fame, Government Executive Hall of Fame, Women Aviators Hall of Fame, Women Divers Hall of Fame, and Ohio Veterans Hall of Fame. She was recognized by Time Magazine in 2017 as one of the 46 distinguished First Women one of the 15 Women Changing the World by the World Economic Forum (2015) and one of Time’s 100 Most Influential People (2014). She has been awarded the Nevada Medal, the Explorers Club Medal, the Rachel Carson Award, an Emmy and nine honorary degrees.

She is the author of the children’s book *To the Stars!* (Charlesbridge Press, 2016) and *Handprints on Hubble, An Astronaut’s Story of Invention* (MIT Press, 2019). In 2021 she was appointed by President Biden as a member of the President’s Council of Advisors on Science and Technology.

STUDENT PRESENTATION SCHEDULE

Poster Presentations // Capital Center Field House // 10:30 am – 11:50 am

Corinne R. Adams, Walnut Hills High School*Poison Ivy Withstands Washing***William J. Berschback, Ottawa Hills Junior/Senior High School***Detecting Ancient Stellar Clusters in Galaxies Similar to the Milky Way Using the Hubble Space Telescope***Destany Bluester, Cypress High School***Correlating Juvenile Delinquency with Childhood Trauma and Poverty within Cypress High School***Quinn Carter, Sylvania Northview High School***The Study of Cell Structure Bioinformatics: Structures and Interactions between Viruses and Specific Interferon Regulatory Factors***Ryan Chang, University School***Qualities of Life of Left Hemispheric and Right Hemispheric Ischemic Stroke Patients: A Meta-Analysis***Grant Congdon, West Geauga High School***Analyzing Electromyography and Acceleration Data from Cervical Rotation and Flexation to Drive an Electric Wheelchair***Kacy Connolly, Hilltop High School***Combinations of Benzoyl Peroxide and Natural Products on Bacteria Prevention***Carlton Cort, University School***Designing and Testing a Prototype Automatic Electronic Control System for Active Magnetic Levitation of a Ferromagnet toward Magnetically Deflected Ballistic Mass Technology***Harbir Dass, University School***Suspension Design for an Off-Road Vehicle***Charles J. Delaney, Bio-Med Science Academy***Assessing High School and College Students Misconceptions in Astronomy***Rohan Desai, Hawken School***Association of Socioeconomic Status with Acute COVID-19 Infection Case Fatality and Lung Cancer Incidence: A County-by-county Analysis for Ohio***Dylan Fertel, University School***How Efficient is Poly Lactic Acid in Delivering Lactase Enzymes?***Abem Fetene, University School***Seaweed Carbon Sequestration***Greg Gerten, Marysville Early College High School***Paintball – Feel the Pain***Carsyn Kaylene Hagans, Archbold High School***The Effects of Light Pollution on Diel Vertical Migration in *Daphnia magna****Juliella Hankinson, Hankinson Home Academy***A Study of Variables Effecting Chloride Levels in Tributaries from Excessive Use of Road Salt***Josie Jennings, Global Impact STEM Academy***How Does Temperature Affect Zebrafish Sex Determination?***Kara Jones, Central Christian School***Inoculating Soilless Growing Media with Mycorrhizae Accelerates Fruit Development in Tomato Plants***Abigail Kittles, Global Impact STEM Academy***Caffeine Amounts in Different Roasts of Coffee Beans***Ally Lewis, Bellbrook High School***The Effects of Menstrual Stigmas and Shame***Kenan Maaieh, Ottawa Hills High School***Effects of TDZD and LKE on the Cognition of Zebrafish Model of Okadaic Acid Induced Alzheimer's Disease***Bryn Morgan, West Geauga High School***A Modern, Software Based Approach to Celestial Navigation***Rayanne Mustapha, The Bounty Collegium***Novel Solutions to Increase Protection in Contact Sports***Dipakshi Pal, Sylvania Northview High School***Detection of Reactive Oxygen Species during Photodynamic Therapy***Deepthisri Paruchuri, Olentangy High School***The Domestic Greywater Treatment by Natural Coagulants*

Varun Ramanujam, Dublin Jerome High School
Which Tomato has the Most Active Vitamin C when Cooked?

Javeria Shaikh, Dayton Regional STEM School
Water Filtration

Eva Wanek, Marion L. Steele High School
An Evolutionary Approach to Inverse Molecular Design for the Discovery of Novel Compounds

Oral Presentations // 2:00 pm – 4:30 pm

2:00 pm

Elsa Zhou, Indian Hill High School
Effects of the Pandemic on Adverse Event Reports of Cardiovascular Medical Device Failure: Implantable Cardioverter Defibrillators, Coronary Drug-eluting Stents, Percutaneously Delivered Aortic Valves, and Non-allograft Tissue Heart Valves
 Blackmore Library 110

Vishwum Kapadia, University School
Correlation of Biofeedback Parameters with the Perception of Relaxation
 Blackmore Library 115

Anna Catherine Sansalone, Summit Country Day School
Monitoring Montana's Waters: Macroinvertebrate and Water Quality Project
 Blackmore Library 119

Alex Devine, University School
Testing Graphene as a Replacement for Indium Tin Oxide in Dye-Sensitized Solar Cells
 Blackmore Library 206

Avery Simon, Hathaway Brown School
Creating an Autonomous Maze Navigator to Generate Interest in Machine Learning Among Children
 Troutman Hall 112

Raymond Flowers, IV, Sylvania Northview High School
Building Better Loot Boxes with Cardano
 Troutman Hall 114

2:30 pm

Ramya Rajan, William Mason High School
Identification of Novel Genetic Biomarkers with Prognostic Utility in Lung Adenocarcinoma
 Blackmore Library 110

Kaitlyn Greppin, Hathaway Brown School
Epidemiology of Pineoblastoma in the United States, 2000-2017
 Blackmore Library 115

Johannes Demessie, William Mason High School
Removal of Arsenic (III) and Chromium (VI) from Contaminated Water using a Chitosan Coated Polymers
 Blackmore Library 119

Shruthika Araselvan, Hathaway Brown School
Impact of Upf2 and Upf3 protein over-expression on the efficiency of targeting mRNAs to Nonsense-Mediated mRNA Decay (NMD)
 Blackmore Library 206

Haasini Mendu, William Mason High School
A Machine Learning Approach for the Early Detection of Parkinson's Disease Based on Acoustic Measures
 Troutman Hall 112

Emir Tali, William Mason High School
Investigating Dynamic Charging - Wirelessly Charging an Electric Vehicle
 Troutman Hall 114

3:00 pm

Rohan Kumar, University School
A Study of EphrinB2 in Global Cellular Tyrosine Phosphorylation in Esophageal Adenocarcinoma
 Blackmore Library 110

Amelia Campbell, Tippecanoe High School
Survivability of Lactobacillus Rhamnosus in the Large Intestine with the Use of Amoxicillin
 Blackmore Library 115

Dylan Berr, University School
Testing the Degradation of Carbohydrate Reinforced Materials Using a Mass Loss System
 Blackmore Library 119

Alexander Vincenti, University School
Determining Whether Differentiated Glioma Cells Further Enhance the Bidirectional Interaction between Glioma Stem Cells and Platelets in Glioblastoma Multiforme
 Blackmore Library 206

Mihai Crisan, Upper Arlington High School
Development of a Generic Nanophotonic Processor using Programmable Photonic Integrated Circuits (PPICs)
 Troutman Hall 112

Ryan McGinnis, West Geauga High School
Electrolysis of 3D Polylactic Acid (PLA) for Custom Fabrication of Sustainable Electromagnets
 Troutman Hall 114

3:30 pm

Chinmay S. Khare, Ottawa Hills High School
Aqueous Solutions of Sensor Molecules Exhibit Fluorescence Changes in the Presence of Oxidants or Plasma Irradiation
 Blackmore Library 110

Tommy Blossom, University School
The Effect of Diet on Aviator Performance
 Blackmore Library 115

Julia Zhu, Hathaway Brown School
C19orf12 Ablation Caused Mitochondrial Dysfunction and Susceptibility to Ferroptosis in Neuronal Cell Model of MPAN
 Blackmore Library 119

Kailey Takaoka, Hathaway Brown School
Epidemiology of Choroid Plexus Tumors in the United States, 2004-2017
 Blackmore Library 206

Laasya Acharya, William Mason High School
Ceres: A Novel Device Utilizing Raspberry Pi & Neural Networks to Detect Crop Diseases Using Imaging
 Troutman Hall 112

Alexander Kmetko, University School
Testing Hexagon Supports on an Airfoil to Make it Lighter
 Troutman Hall 114

4:00 pm

Emaad Khan, Sylvania Southview High School
Neuroinflammation and Neurodegenerative Diseases
 Blackmore Library 110

Weining Wang, University School
Investigating Hydrogen Production Enzyme using Gaming GPU
 Blackmore Library 119

Hans Swain, University School
Effect of Excess Dietary Iron on Intestinal Tumorigenesis
 Blackmore Library 206

Justice Arai, University School
Developing Propellers with a Fringed Trailing-Edge Inspired by Owl Flight to Reduce Noise
 Troutman Hall 114

ABSTRACTS

Laasya Acharya, William Mason High School

Ceres: A Novel Device Utilizing Raspberry Pi & Neural Networks to Detect Crop Diseases Using Imaging

Oral Presentation: Troutman Hall 112 // 4:00 pm

Globally food demand is increasing; at the same time, about 10-20% crop is damaged/wasted during production/harvest due to pathogens. This could be reduced with early detection of crop diseases. Current methods rely heavily on time consuming processes of lab testing/expert validation. Ceres, the proposed solution, is an affordable, accurate, scalable device to detect the crop diseases infield/onsite. Early detection helps take preventative measures to stop disease spread. Ceres was trained using the images collected from the growers/universities. These images were validated by the experts. In total, about 13,000 images were collected/validated across 14 crop/fruit/vegetables and 24 diseases. The Ceres model consisted of a total of 12 layers of 6 distinct types for training. A median filter and feature extraction were used so that the model can focus on the contents of the image. For prediction, it was fed images which were not seen earlier. The training and prediction images were divided in 70%/30%. The prediction results suggests that Ceres has accuracy of 89% with F-score of 92.4. The Ceres physical device is easy to use - where the user captures the image, it is analyzed within 2-3 seconds and results are displayed on the screen. Ceres consists of a 3D-printed device, a Raspberry Pi, camera, LCD, and a button to take the image. Overall, Ceres was able to completely fulfill its design criteria. In conclusion, this project shows that a neural network with multiple layers can be developed in conjunction with a physical device for early detection of crop diseases.

Corinne R. Adams, Walnut Hills High School

Poison Ivy Withstands Washing

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Textbooks, physicians, researchers, and even the media commonly quote the same seminal study demonstrating how much poison ivy one can prevent by washing after several time points. This study hypothesized that subjects could not prevent poison ivy dermatitis by washing, even after 5 minutes. To evaluate this hypothesis, muddled poison ivy was applied to the skin in 8 tape marked squares. Investigators washed, with soapy water, areas at seven time points: immediately, 5, 10, 15, 30, 45, and 60 minutes. The control square was not washed. The presence of pruritus and level of erythema was measured daily for 10 days. Only immediately washing after leaf exposure prevented poison ivy; areas washed just 5 minutes after exposure still developed dermatitis. The longer one waits to wash the exposed skin, the greater the sum of erythema over the 10 days of the study. Washing 10 minutes after exposure had a statistically less overall erythema sum over 10 days compared to washing after 60 minutes ($p = 0.03$). This study represents the first study to demonstrate that only immediate washing after exposure plant exposure will prevent poison ivy. Since one has less than 5 minutes to wash poison ivy oil from their skin, primary prevention best includes wearing clothes to cover exposed skin or applying commercially available poison ivy barrier cream. Also, one should critically review primary references in textbooks and journal articles.

Justice Arai, University School

Developing Propellers with a Fringed Trailing-Edge Inspired by Owl Flight to Reduce Noise

Oral Presentation: Troutman Hall 114 // 4:00 pm

Of the many origins of noise, aerodynamic fans and propellers are significant contributors, such as the ones used in ventilation, aircraft, and electrical generation. Fans and propellers produce noise in many spots throughout blade, but a considerable amount is produced at the trailing edge. Owl wings are well-known for their ability to minimize the turbulence all while preserving aerodynamic efficiency through unique features, one of which are fringes at its trailing edge. The use of this feature was tested to predict the reduction of noise in man-made propellers. Two 17.5 cm propellers were designed by the author in a modeling software (Blender) and 3D printed. Each blade was experimented on a 3V DC motor with two 1.5V AA batteries providing 3V at 900 RPM. Data was acquired using MacBook Pro microphones and Sound Meter, a decibel meter application. Each sample was 60 seconds, and data was recorded every 1 second. An independent sample t-test was performed to compare the decibel between the control propeller and the modified propeller. There was a significant difference in decibels between the control propeller ($\bar{x} = 27.00$, $SD = 0.527$) and the modified propeller ($\bar{x} = 26.19$, $SD = 0.707$); $t(118) = 7.0514$, $p \leq 0.0001$. This

study showed that fringed propellers using fringed trailing edges inspired by owl wings are quieter than non-fringed propellers. The noise reduction was approximately 0.81 dB. Further testing will allow its use in practical applications such as drones, ventilation, and similar small-scale uses.

Shruthika Araselvan, Hathaway Brown School

Impact of Upf2 and Upf3 protein over-expression on the efficiency of targeting mRNAs to Nonsense-Mediated mRNA Decay (NMD)

Oral Presentation: Blackmore Library 206 // 2:30 pm

Nonsense-mediated mRNA decay (NMD) is a quality control mechanism in the gene expression pathway that ensures the degradation of mRNAs that do not complete translation to produce full-length polypeptides that form fully functioning proteins. The Upf proteins (Upf1, Upf2, Upf3) function in a complex to identify NMD substrates and elicit their degradation. Upf1 binds to the mRNA and is displaced by the translating ribosome as it moves along the open reading frame, while Upf2 binds to Upf1 and acts as a scaffolding protein between Upf1 and Upf3. Upf1 accumulates downstream of the stop codon and it's likely that the probability of an mRNA being degraded by NMD depends on the length of the mRNA downstream of the stop codon that is available for Upf1 to bind and the abundance of the Upf proteins. Prior research in our lab has suggested that overexpression of all three Upf proteins leads to a decrease in the accumulation of PTC-containing mRNA. This project was designed to determine the impact of overexpression of only Upf2 and Upf3. *Saccharomyces cerevisiae* cells were transformed with plasmids containing Upf2 and Upf3 overexpression alleles. Whole cell RNA and protein from the overexpression cell cultures were extracted and analyzed through a northern blot analysis for RNA and a western blot analysis for proteins. From this study, we concluded that overexpression of all three Upf proteins is required for increasing NMD efficiency as the overexpression of Upf2 and Upf3 alone was insufficient to cause a decrease in accumulation of reporter mRNAs.

Dylan Berr, University School

Testing the Degradation of Carbohydrate Reinforced Materials Using a Mass Loss System

Oral Presentation: Blackmore Library 119 // 3:00 pm

The goal of this project was to test the capacity of chitosan and cellulose layering to increase the water resistance of corrugated cardboard. The expectations were that samples with a greater number of layers would degrade at a slower rate, and therefore maintain structural integrity for a longer period of time in the presence of water, and that samples would degrade faster in full spectrum lighting and warmer temperatures. Sixty cardboard samples were layered with chitosan and cellulose through rolling two application rollers that had been dipped in slurries of water and carbohydrates across the surfaces of the materials. After being massed, the materials were placed into four tanks that approximated the conditions of the Great Pacific Garbage Gyre (tank 1 (23 °C) tank 2 (15 °C) and tanks 3 and 4 added full spectrum lighting). All tanks had a pH of 8. For a period of one month, the materials were dried and massed every week. Through tracking changes in mass, it was seen that the greatest percent change of degradation occurred in tanks 1 and 3, which had warmer temperatures, while 3 had full spectrum lighting. The lowest percent change of degradation occurred in tank 2 which was far colder and lacked any lighting. The results also showed that the degradation decreased as the number of layers increased. This is most likely because the addition of carbohydrates adds a layer of cohesion to the internal structure of the cardboard, slowing down the process of degradation after chemical hydrolysis.

William J. Berschback, Ottawa Hills Junior/Senior High School

Detecting Ancient Stellar Clusters in Galaxies Similar to the Milky Way Using the Hubble Space Telescope

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Globular Clusters are cosmological clocks found in each spiral galaxy. These unique stellar objects hold information about the age, chemical composition, and major events that occurred in the parent galaxy. Despite living in a spiral galaxy (the Milky Way), we still know very little about the globular cluster systems in spiral galaxies because these clusters can mostly only be detected using the Hubble Space Telescope, which currently provides the best data quality at visible wavelengths. The goal of this project, which is being conducted by a multi-national group of astronomers, is to create the first systematic and homogeneous catalog of ancient globular clusters in 19 spiral galaxies, in order to understand their mass, metallicity, and size distributions, and how these

vary with properties of the host galaxy. This paper specifically focuses on the visual classification of candidate globular clusters, as this is a vital step to dissecting contaminants in the preliminary machine learning (ML) catalogs created by neural networks used by the PHANGS-HST collaboration. Reviewing the ML sources either confirms or rejects the algorithm's determinations of a good globular cluster. My results show that the ML catalogs have an accuracy of ~80% in their automated globular cluster selection. These confirmed globular clusters will be compiled in a new catalog, and their already measured properties, such as luminosities, colors, and sizes, will be compared with properties of their host galaxies across the entire sample.

Tommy Blossom, University School

The Effect of Diet on Aviator Performance

Oral Presentation: Blackmore Library 115 // 3:30 pm

Aviators who are exposed to multiple long duration, high altitude flights often experience cognitive fatigue post-flight. One underlying cause could be connected to diet. Recent studies show a relationship between diet and the inflammatory response. In response to inflammation, various inflammatory biomarkers are secreted. This study observes the effects of an aviator's diet on their cognitive performance and determines if there is a relationship between high-inflammatory diets and fatigue levels. Aviators were assessed over a week, including a 24-hour diet recall, a self-administered five-category multidimensional fatigue index (MFI) test, and blood biomarker analysis. Using the diet recall, a pro-inflammatory score was given for each day. Scores were then compared against each participant's MFI and various biomarkers. Aviators were separated into two groups, those whose inflammatory scores increased and those who did not. Biomarker concentrations at each time point were compared between the two groups. Ghrelin, an inflammatory biomarker associated with hunger, showed a statistically significant difference at the final time point ($p = .028$), but not at baseline ($p = .236$) or midweek ($p = .071$). The aviator group with decreased/unchanged inflammatory scores showed a higher concentration (270 pg/ml) of ghrelin at the final time point than those with an increased inflammatory score (150 pg/ml). However, no direct relationship between inflammatory scores and MFI data was present. There was no direct relationship between inflammatory scores and inflammatory biomarkers. Though dietary inflammation showed no relationship with fatigue, the relationship between inflammatory scores and ghrelin suggests that inflammatory scores could affect hunger.

Destany Bluester, Cypress High School

Correlating Juvenile Delinquency with Childhood Trauma and Poverty within Cypress High School

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

The factor that motivated this research was the growing youth delinquency in Mansfield, Ohio, and the expanding body of evidence that a correlation exists between children who experience abuse and poverty with juvenile delinquency (Herrenkohl, 2017). This project was designed to help my peers and community understand how childhood trauma and poverty lead to juvenile delinquency. With this knowledge, we can increase our understanding of juvenile delinquents and work to increase funding for abuse and underprivileged youth. Acquiring knowledge in this area can help young people become more aware of their own cultural identity, help them understand differences and similarities among and within social groups, and encourage them to value the importance of the development of positive mental health, which may lead to a decrease in criminal behavior. We pulled qualitative and quantitative data from an anonymous online survey that was created using google forms. This survey was sent to the entire Cypress High student body. We used the results from 42 surveys and averaged the responses. The questions that were asked included race, age, childhood experiences, crimes committed, and family history. Survey results indicated a correlation between Cypress students' childhood trauma, loss of a parent due to incarceration, divorce, or death, and poverty with an increase in juvenile delinquency. Survey results indicated that 83.87% of the student body had suffered some form of childhood abuse including verbal, physical, and sexual abuse, 56.1% were a witness to abusive behavior, and 68.3% of students stated that have gone to jail, DH, prison or been arrested/cited.

Amelia Campbell, Tippecanoe High School***Survivability of Lactobacillus Rhamnosus in the Large Intestine with the Use of Amoxicillin***

Oral Presentation: Blackmore Library 115 // 3:00 pm

The recommendation of taking probiotics in conjunction with prescribed antibiotics is a rapidly evolving field in gastrointestinal research. Limited in-vivo research has proven that the use of probiotics is effective in reducing damage that antibiotics have on the microbiome of the colon. However, a majority of these studies were performed using antibiotics and probiotics sequentially, not simultaneously. This experiment used a simplified in-vitro model of the human digestive process to determine the survivability of the probiotic strain Lactobacillus Rhamnosus when taken in concurrence with amoxicillin. It was assumed that the highly acidic concentration of the stomach and the corrosive digestive enzymes found in the small intestine would reduce observed colonies of Lactobacillus. To test this experiment, four beakers were used to simulate the major parts of the digestive system: the mouth, the stomach, the small intestine, and the colon. The contents of one beaker were poured into the next and the pH of each beaker was adjusted accordingly. A Culturelle probiotic tablet was introduced to the system. Two hours after the capsule entered the mouth, an amoxicillin pill was introduced to the refilled "mouth" and the process continued accordingly. Another Culturelle tablet was used, "restoring" lactobacillus to the colon. After each beaker, the contents were swabbed onto an MRS agar plate. There was zero lactobacillus growth found on any plate after exposure to stomach acid. This experiment was unsuccessful in answering the initial purpose, but it proved that Culturelle probiotics capsules do not survive the harsh conditions of the stomach.

Quinn Carter, Sylvania Northview High School***The Study of Cell Structure Bioinformatics: Structures and Interactions between Viruses and Specific Interferon Regulatory Factors***

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

The Covid-19 virus is a severe illness that has caused a worldwide pandemic and millions of deaths. Covid-19 works directly against the human immune system and affects how it fights off the virus in the body. Interferon regulatory factors (IRFs) are essential parts of the immune system's ability to work correctly, vital to fighting off viruses such as Covid-19. Understanding the interaction between the IRFs, specifically IRF3 and IRF7, and SARS-CoV-2 7a, a strain of the Covid virus, could lead to better treatments for patients. This study utilized four interconnected computer programs to find the most likely binding configurations for IRF3 and IRF7 with SARS-CoV-2 7a and visualize the predicted structure of the IRF proteins. Using PDB editor, PEP-FOLD, and Visual Molecular Dynamics (VMD), the IRF3 and IRF7 were successfully modeled as large proteins with complex folding patterns. After successfully visualizing the proteins, the Z-Dock program was utilized to find the protein's binding site and virus of interest, producing a file with the capability to see how they interacted. Finally, using the file output from Z-Dock, VMD was used again to visualize the different docking possibilities and see the protein structure when interacting with the Covid strain. There are five different visualizations with the highest binding affinity, which can help in the future to study the virus' interactions with our immune system and to find better ways to aid our bodies in the struggle against the virus.

Ryan Chang, University School***Qualities of Life of Left Hemispheric and Right Hemispheric Ischemic Stroke Patients: A Meta-Analysis***

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Ischemic strokes account for 87% of all strokes and occur when blood flow in the brain is blocked from blood clots or fatty deposits. Depending on which hemisphere the stroke affects, different effects will be seen. This meta-analysis aimed to determine what hemisphere would be more likely to recover after an ischemic stroke based on the results of the quality of life scales. A literature search was conducted on Pubmed, EBSCOHost, and PLoS One with the search terms "ischemic stroke," "rehabilitation," "Barthel Index," and "Rankin Scale." Patients were adult patients with ischemic stroke onset confirmed with medical records, imaging studies, and clinical examinations. 287 articles were reviewed. Seven articles were identified. There were a total of 413 patients inflicted with ischemic stroke remaining after the studies were completed, with 234 patients inflicted with left-sided hemiplegia and 179 patients inflicted with right-sided hemiplegia. The two groups were comparable, with similar demographics. Through BI scores, ischemic stroke was significantly reduced (95% confidence interval (CI): 67.95 to 80.67, I2 = 76%). Through mRS scores, ischemic stroke was not significantly affected (95% CI: 2.72 to 3.28, I2 = 89%). Current evidence

suggests that the effects of ischemic stroke can be reduced through treatments used in the studies, but further evidence will need to be gathered to determine which hemisphere is more likely to recover.

Grant Congdon, West Geauga High School

Analyzing Electromyography and Acceleration Data from Cervical Rotation and Flexion to Drive an Electric Wheelchair

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

In recent years, prosthetics from hands to feet have become more affordable. They have also changed many people's lives by giving them back their mobility, yet wheelchair technology has remained limited to primarily arm-driven navigation and is still useless to many quadriplegics. Current solutions to these dilemmas are often extremely costly or follow a very binary maneuvering method. A wheelchair prototype was developed to solve these issues using newly available high accuracy accelerometers and biosensing boards with electromyographic detection compatibility. It records head and neck motions that closely correlate to natural walking movements to drive and steer a prototype smart wheelchair. By using a biosensing board attached to a headset, data from electromyography and acceleration sensors are sent to a Raspberry Pi Zero for analysis which communicates with an Arduino to drive the prototype. By tilting the cranium forward or rotating the cervix, the wheelchair will be driven forward or turn to the right or left respectively. This method of driving the prototype wheelchair can be applied to a full-sized wheelchair with minimal additional costs. The total cost of a smart wheelchair would be very similar to the current power wheelchair, yet it would have more natural steering mechanisms, have increased customizability in velocity, and can collect anonymous data to optimize performance.

Kacy Connolly, Hilltop High School

Combinations of Benzoyl Peroxide and Natural Products on Bacteria Prevention

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

The goal of the experiment was to find antibacterial agents that work effectively in preventing bacterial growth. Facial bacteria was collected from human subjects. Discs were soaked in 2.5%, 4%, and 10% benzoyl peroxide, honey, witch hazel, tea tree oil and all combinations. After incubating 48 hours, rings of inhibition were measured. The first hypothesis, stating 10% BP would be most effective, was not supported. The 4% BP produced the largest rings (7.1mm), followed by 10% BP (5.6mm), and then 2.5% (5.3mm). There was no statistical difference between the BP concentrations. The second hypothesis, stating TTO would be the strongest antibacterial of the natural agents, was partially supported. TTO produced rings averaging 5.6 mm, WH rings were 2.7mm, and honey was 0mm. There was no statistical difference between TTO and WH, but both were significantly more effective than honey ($p < 0.01$). Compared to natural agents, BP produced average rings of 6mm while the average of all the natural agents was 2.8 mm, which was significantly more effective ($p = 0.0012$). The final hypothesis, stating BP+TTO would be the strongest antibacterial combination, was statistically significant ($p = 0.0001$). BP+TTO produced 9.5mm rings, BP+WH's were 5.0mm, and BP+Honey's were 4.2mm. The comparison of BP+TTO (9.5mm) to all BP averages (6mm) showed this combination statistically increased effectiveness ($p = 0.0012$).

Carlton Cort, University School

Designing and Testing a Prototype Automatic Electronic Control System for Active Magnetic Levitation of a Ferromagnet toward Magnetically Deflected Ballistic Mass Technology

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Magnetically deflected ballistic mass (MDBM) describes a system in which a metal rotor, the mass in the system, is suspended inside an evacuated sheath similarly to how a maglev train is levitated. The suspended metal rotor can be accelerated to high speeds. Because the rotor is in a near frictionless environment, inertia allows storage of energy in the movement of the rotor with minimal energy losses over time. This project takes the first step towards MDBM technology by designing and testing a non-linear active control system for a simulated MDBM control system. A mild-carbon steel caster ball and disc were selected to be the ferromagnetic objects for the system. The electronics used to control the electromagnets were an Arduino Mega, L298N motor driver, 24V DC power supply, and two 24V DC electromagnets. An Arduino Uno was used for data collection. The sensor system was an analog rotary potentiometer integrated with the test rig and ferromagnet by a lever system. This control system

can power the electromagnets at 256 different steps using PWM, allowing for precise control of the electromagnets power at speeds much faster than can be manually achieved. The control algorithm, which is a heavily modified PID algorithm, can bring large displacements to within an average $\pm 0.5\text{mm}$ of the setpoint in 227ms and fine tune the correction to within an average of $\pm 0.06\text{mm}$ of the setpoint within another 10.318 seconds. As such, it is a successful prototype that can be implemented in a future MDBM system with minimal tuning.

Mihai Crisan, Upper Arlington High School

Development of a Generic Nanophotonic Processor using Programmable Photonic Integrated Circuits (PPICs)

Oral Presentation: Troutman Hall 112 // 3:00 pm

Computing has become a pillar in propelling much of the modern progress scientific progress for more than half a century. However, exponential trends within digital electronic computing systems in traditional, silicon-based transistor technology has, over this decade, sharply declined. The firmly established paradigm of miniaturization and scaling of transistors is approaching fundamental physical limits. Without a viable alternative form of computing to address the physical limitations of transistors, this threatens to slow progress within both the semiconductor and microelectronic industries. The goal of this engineering paper was to design a proof-of-concept generic nanophotonic processor that addressed the inherent scaling issues with microelectronics while providing greater computational performance. The hardware platform, silicon photonics, utilizes a linear combination of directional couplers and thermo-optic phase shifters to compute matrix-vector products. These key hardware elements were designed and optimized through finite-difference-time-domain (FDTD) simulations. Software control algorithms with graph theory were implemented for the routing and processing of optical signals. With this, three key optical path distribution problems were addressed using graph theory and iterative heuristic algorithms: the Single Input-Output Pairs, Multiple Input-Output Pairs, and Single Input with Multiple Outputs problems. Additionally, a new fabrication tolerant waveguide mesh was designed for the implementation of the photonic components on a silicon-based platform. From the simulations, it was determined that the theoretical operational frequency of the nanophotonic processor was 79.52MHz. The software control algorithms had an average duration 0.003664 seconds to calculate an optical path, which was shown to be 13.3 times faster than algorithms previously developed.

Harbir Dass, University School

Suspension Design for an Off-Road Vehicle

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

The suspension of a vehicle is the system that both holds the vehicle up and allows the wheels to move independently vertically from the frame. The main component of the suspension is the linkage that connects the wheels to the frame and allows for this vertical movement. The function of the suspension is to absorb bumps in the terrain and to maximize grip. The purpose of this research is to determine if, or how much better having suspension is on an off road go kart versus not having suspension. This was done by doing multiple timed lap times on a dirt track and by driving over a fence post while taking video footage of the kart at a specific distance away from the kart in order to show the vertical displacement of the frame. The problem with the kart without suspension was that the ride quality was too bumpy and causes driver fatigue. The suspension should absorb these bumps and allow the driver to drive as fast as possible without becoming fatigued. Since karts do not have a differential, the inside rear tire needs to be unloaded to corner properly, which is done using caster without suspension. With suspension, this was done by having the front suspension softer than the rear. The suspension was successful if the lap time of the kart is faster with the suspension than without it and if there was less vertical displacement of the frame in the fence post trial with the suspension. The average lap time of the kart without suspension was 24.36s, and the average lap time of the kart with suspension was 21.70s. The vertical displacement of the frame without suspension was about 127mm and with suspension it was about 50.8mm. Since the lap time was faster and there was less vertical displacement over the fence post, the suspension was a success.

Charles J. Delaney, Bio-Med Science Academy

Assessing High School and College Students Misconceptions in Astronomy

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

A study was conducted to assess misconceptions carried by high school and college students in the field of astronomy. Participants in high school attended Bio-Med Science Academy and the participants in college attended Kent State University. A survey was created with questions inspired by the literature, containing 18 multiple choice questions on various astronomical phenomena and misconceptions associated with each. These questions included misconceptions about the Earth's orbit, the cause of seasons, the moon's phases, the age of the universe, and how astronomical bodies behave. A unique aspect of this project was assessing respondents' confidence in each answer using a four-point scale. Respondents were also prompted to fill out personal information including gender, age, career interest, and more. There were many significant differences in the results of misconceptions and confidence between gender and high school and college groups. In particular, overall scores for males and females were not significantly different, but the males' confidence in their responses was significantly greater than the females' ($p \leq 0.001$).

Johannes Demessie, William Mason High School

Removal of Arsenic (III) and Chromium (VI) from Contaminated Water using a Chitosan Coated Polymers

Oral Presentation: Blackmore Library 119 // 2:30 pm

Access to clean water has been a global challenge since long-term exposure to heavy metal pollutants such as arsenic (As(III)) and chromium (Cr(VI)) has detrimental health effects. Thus, developing a low-cost technology to provide clean drinking water is vital. A novel adsorbent was developed by coating chitosan, a naturally and abundantly available biopolymer, with three selected types of waste plastics. Three waste plastic materials, polypropylene (PP), polyamide (PA), and polystyrene (PS), were screened for adsorbent support, and Polyamide (Nylon-12 nano-bead) was selected. The biosorbent was characterized by Fourier-transform infrared spectroscopy (FTIR) spectra, thermogravimetric analysis, surface charge analysis, and imaging techniques. The removal of Cr(VI) and As(III) was determined using inductively coupled plasma-atomic emission spectrometry (ICP-AES). Equilibrium and column flow adsorption of As(III) and Cr(VI) on the biosorbent were studied. The effect of pH, concentration of adsorbate and amount of adsorbent on the removal efficiency were investigated. Equilibrium data were fitted to Langmuir and Freundlich adsorption isotherms, and the maximum monolayer adsorption capacities were 98.9mg/L and 21.5mg/g for Cr(VI) and As(III), respectively. Kinetics studies and column performance were studied on the effects of chitosan-PA for inlet Cr(VI) and As(III) solutions. The adsorbent's breakthrough curve was analyzed using the bed-depth service time Thomas model to define breakthrough behavior. Novel regeneration and reuse of exhausted adsorbents was achieved via use of a chelating ligand complex EDTA (ethylenediaminetetraacetate) solution, effectively lengthening the lifespan of the adsorbent. Use of this adsorbent-system could improve the quality and accessibility of water in developing countries.

Rohan Desai, Hawken School

Association of Socioeconomic Status with Acute COVID-19 Infection Case Fatality and Lung Cancer Incidence: A County-by-county Analysis for Ohio

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Many acute and sub-acute diseases have unexplained residual risk and social determinants of health (SDOH) are increasingly being recognized as crucial predictors of outcomes. We hypothesized that there was a significant association between SDOH and acute (COVID-19 infection) and sub-acute (lung-cancer) respiratory diseases. Socioeconomic data for the state of Ohio was manually collected. Lung cancer incidence was acquired from the National Cancer Institute's online portal. COVID-19 case fatality ratios were downloaded from Johns Hopkins University's GitHub repository. All datasets contained complete information for Ohio's 88 counties and were merged by county name. Data manipulation, visualization, and statistical inference was conducted using R programming (tidyverse, maps, and corrrplot packages). Median county-level income across Ohio was \$52,722 (Inter quartile range or IQR: 47,273-59,166). Median county-level lung cancer incidence was 68.4/100,000 population (IQR: 62.0-80.6) and median COVID-19 case fatality ratio was 1.98% (IQR: 1.65-2.36). Lung cancer incidence and COVID-19 case fatality ratio were not significantly correlated ($n = 88$, $p > 0.05$). In contrast, median income was significantly correlated with both, lung cancer incidence ($r = -0.49$, $p < 0.001$) and COVID-19 case fatality ratio ($r = -0.41$, $p < 0.001$); 24% of lung cancer incidence and 17% of

COVID-19 case fatality ratio in counties across Ohio was explained by median county income. As median income of Ohio counties decreased, the likelihood of dying due to COVID-19 and getting lung cancer increased, suggesting that SDOH is crucial in outcomes of acute and sub-acute diseases.

Alex Devine, University School

Testing Graphene as a Replacement for Indium Tin Oxide in Dye-Sensitized Solar Cells

Oral Presentation: Blackmore Library 206 // 2:00 pm

Traditional silicon solar panels are too expensive to be widely implemented. While silicon is plentiful, manufacturing silicon solar cells is a difficult and expensive process. This research sought innovative ways to improve the cost-efficiency and environmental friendliness of solar energy. Dye-sensitized solar cells replace silicon with zinc oxide or titanium dioxide, two materials commonly found in sunscreen, and fruit dyes from raspberries, blackberries, and blueberries. The fruit dye absorbs the light and converts it into electricity, and the zinc oxide or titanium dioxide transport the electrons through the cell. In a previous experiment, a dyesensitized solar cell was made with zinc oxide and was dyed in blueberry dye for 135 minutes, producing 0.53v. This solar cell was not as cost-effective as silicon solar cells, and some changes were identified to possibly increase the cost-effectiveness in extending the dye time, using another source of light, and replacing the expensive indium-tin oxide (ITO) glass slides with graphene-coated glass slides. These changes were implemented into the cells in this experiment to find the most cost-effective solar cell. Out of the cells made, the most productive cell was a titanium dioxide cell dyed in raspberry dye for 240 minutes, producing 0.57v. The most effective cell made with graphene was a zinc oxide cell dyed in raspberry dye for 240 minutes, producing 0.17v. Since the graphene cell was significantly less expensive than the ITO cell, even with a lower voltage, was more cost-effective than the ITO cell, but less cost effective than silicon.

Dylan Fertel, University School

How Efficient is Poly Lactic Acid in Delivering Lactase Enzymes?

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

This project was designed to test the effectiveness of Polylactic acid (PLA) for the use of drug release. The pill Lactaid was used for testing. Lactaid pills contain lactase enzymes which are able to break down lactose into smaller, simpler sugars: glucose and galactose. Many with lactose intolerance use these pills, as they have a lactase enzyme deficiency. A dip coating method was used to coat the Lactaid in PLA. The PLA was turned into a liquid form by dissolving it in Dichloroethane. By using this method, the state of the PLA was changed from a solid to a liquid. Once coated in the PLA, the polymer was covered in a layer crushed Lactaid pill. Finally, the whole pill was dip coated once more to hold everything together. To test the efficiency of the PLA a mass loss process was used. The pill was put in 100ml of 0.1 molarity Hydrochloric acid (HCl) on a stir plate. After 45 minutes of the pill stirring, the pill mixture was filtered and the HCl was disposed of. Then the remaining Lactaid pill was dried and massed the next day. For my control, a Lactaid pill with no PLA coating was used and put in 100ml of 0.1 molarity HCl. The PLA does help slow the delivery of the drug release, as the percent of mass loss for the PLA pill was less than the percent of mass loss of the Lactaid pill control. This means that PLA can be a great material to prolong drug release.

Abem Fetene, University School

Seaweed Carbon Sequestration

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

The increase of carbon dioxide (CO₂) within the atmosphere has led and will lead to many climate-related problems that will negatively affect ecological communities across the world. The abnormal increase in the emission of carbon dioxide is due to a myriad of factors, including manufacturing, deforestation, and various methods of transportation. In response to this atypical increase, numerous methods of sequestering carbon have been practiced, varying from storing liquid carbon dioxide into geologic formations to compost or manure-based carbon farming. However, the practice of ocean carbon sequestration appears to be less frequent in comparison to many other forms of terrestrial sequestration. More specifically, the use of macroalgae, along with other marine plant life, could have a higher potential for sequestering carbon dioxide than their terrestrial counterparts. This study hypothesizes that there is a correlation between macroalgae growth, observed through mass, with

carbon dioxide present within the environments of the different macroalga, which, if supported, could be a plausible solution for slowing down carbon catalyzed climate problems. Within this experiment, the saltwater macroalgae species', *Ulva Lactuca* and *Gracilaria Parvispora*, were grown for a two-week period with varying carbon dioxide concentrations, with their post-growth period and pre-growth period masses compared as a measurement of growth for each macroalgae species, respectively. In the conclusion of experimentation and data collection, *Ulva Lactuca* displayed an overall stronger correlation of growth to carbon dioxide present within its environment than *Gracilaria Parvispora*.

Raymond Flowers, IV, Sylvania Northview High School

Building Better Loot Boxes with Cardano

Oral Presentation: Troutman Hall 114 // 2:00 pm

Loot boxes are a development of the video game industry. Players buy them for a chance to win one of an array of items in the game. Activision Blizzard and Valve have popularized loot boxes as a profitable avenue for in-game purchases. However, current loot boxes lack transparency of the player's chances of winning particular items and pose possible legal and ethical dilemmas since these purchases lead to > 15% of companies' profits. Blockchain provides an opportunity. Blockchain is essentially a ledger that validates and stores transactions. Blockchain utility has drastically improved since the inception of Bitcoin in 2008. New blockchains, like Ethereum, have introduced programmable transactions (e.g., smart contracts and NFTs) and tokens. Tokens can reference metadata that links to item identification, items in games, and many other uses. Blockchain ledgers are easily accessible by the average person providing transparency when players purchase loot boxes; consumers can view what the loot box holds and past rewards. Ethereum blockchain has developed a loot box, but has low scalability and is expensive (~ \$10 - \$50+ per transaction). Cardano blockchain is more scalable and cheaper (> \$2). This project built a prototype loot box for the Cardano Blockchain using the Plutus Application Framework, a simulator by Input Output HK. The resulting Cardano loot box was successful, randomly sending an item provided by the owner of the loot box to a consumer. Loot boxes on Cardano can significantly improve current Ethereum loot boxes, keeping the achievements of Ethereum while solving current issues.

Greg Gerten, Marysville Early College High School

Paintball – Feel the Pain

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

I enjoy playing paintball but hate the pain of the shot and I wondered what I should wear to better protect while not getting too hot and weighted down. I think thicker materials will protect better against the shot – making it less painful. After thousands of years body armor is still used today to protect against getting injured. Paintball was created in 1981 by Charles Nelson. I setup my experiment using a paintball gun, an accelerometer to measure the shock and different materials (T-shirt, Sweat shirt, jeans, paint ball gear, coveralls and combinations) to measure the average shock from twenty shots against each “Body armor”. While my hypothesis was correct that thicker materials will protect better against the shot – making it less painful, there does appear to be more to the story. The cost benefit of material weight to protection is considered. In conclusion the paint ball gear was the best (shock vs weight) and the t shirt was the worst. It was very interesting to see the relationships between the shock, weight and thickness between each material and the range of measurements between the shots.

Kaitlyn Greppin, Hathaway Brown School

Epidemiology of Pineoblastoma in the United States, 2000-2017

Oral Presentation: Blackmore Library 115 // 2:30 pm

Pineoblastoma (PB) is a malignant brain tumor that originates in the pineal gland. Patients diagnosed with PB experience headaches, sleepiness, vomiting, and vision changes. This epidemiological study was performed to determine at-risk populations, treatment, and prognosis. Data on 1,178 patients with PB were acquired from the Central Brain Tumor Registry of the United States (CBTRUS) from 2000-2017. PB was defined by the International Classification of Diseases for Oncology (ICD-O-3) code 9362/3 and primary site code C75.3. Frequencies and age-adjusted incidence rates and rate ratios per 100,000 were calculated using SEER*Stat. Median survival and survival curves were generated using the NPCR survival database. PB occurred equally in females and males. The incidence rate of PB decreased as age at diagnosis increased with the highest incidence at 00-04 years

(AAIR: 0.05, 95% CI: 0.043-0.058). There was a higher frequency in white patients (71%) compared to black patients (23%) although the incidence rate ratio was higher for black patients (AAIRR: 1.698, 95% CI: 1.473-1.954, $p < .0001$). The incidence rate ratio of black patients stratified by age was highest in pediatric patients 5-9 years (AAIRR: 3.5532, 95% CI: 2.4627- 5.1027, $p < .0001$). However, as age at diagnosis increased, the incidence rate ratio decreased. Survival was lower among patients who did not receive surgery ($p = 0.001$), males ($p = 0.021$), and lowest in children ages 0-4 ($p < .0001$). This study proposes the most current and comprehensive analysis to provide vital information for current clinicians, public health planners, and patients to improve diagnosis and patient care.

Carsyn Kaylene Hagans, Archbold High School

The Effects of Light Pollution on Diel Vertical Migration in Daphnia magna

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Determining how light pollution affects diel vertical migration (DVM) patterns is crucial for understanding feeding relationships in the Great Lakes freshwater ecosystem. *Daphnia magna* were placed into sixty cm vertical water columns divided into three sections. *Daphnia* locations were recorded for alternating dark and light measurements for eight consecutive hours for each 7-watt light source: LED cool (5000K), LED warm (2700K), and incandescent. For the incandescent trials, there were significantly more *Daphnia* located in the lowest chambers ($n = 112$, 93%) compared to the dark trials ($n = 84$, 70%) ($p = .0213$). In addition, the type of light used did affect the DVM patterns. A Chi-square test of the *Daphnia* location showed a significant relationship between the light source and the location of the organisms ($p = .00001$). In the incandescent light, 93% of the *Daphnia* were located in the lowest section of the water column. LED cool light had the greatest amount of *Daphnia* in the upper chamber, 25%. *Daphnia* interestingly showed more positive phototaxis to the LED cool light and a more negative phototaxis to the incandescent light. This project indicates the need for continued research on the effects of artificial light at night (ALAN) and its impact on freshwater ecology.

Juliella Hankinson, Hankinson Home Academy

A Study of Variables Effecting Chloride Levels in Tributaries from Excessive Use of Road Salt

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

The goal is to determine the effect of road salt on Wolf Run, a tributary of the Kokosing River in Knox County, Gambier, Ohio in the Walhonding Watershed. An initial water quality analysis was completed and observations of the surroundings were initially documented. Fall bi-weekly and winter weekly water samples were drawn from Wolf Run testing the chloride levels using chloride testing strips as provided by the Izaak Walton League. The variables measured were width, depth, current precipitation, water and air temperature, using thermometer, tap measure, and official weather websites. Observable macroinvertebrates, flora, wildlife, and any changes in the stream, or the riparian zone were documented each week. Testing results from September 30, 2021 to present: There seems to be a correspondence to lower levels of chloride with higher water levels and vice versa. Cold weather has slowly become more frequent causing varied results. Without further road salting, chloride levels decrease. Broader research shows high levels of chloride tend to collect in one spot harming/killing freshwater life in that area, while areas upstream or downstream may maintain low levels of chloride.

Josie Jennings, Global Impact STEM Academy

How Does Temperature Affect Zebrafish Sex Determination?

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

The world faces growing questions on how to reduce and handle climate change. A large part of handling that problem is to study the ways of how these increasing environmental factors are going to impact our lives. This study aims to determine how temperature increases will affect gender ratios with freshwater species, starting with zebrafish. 2 groups of 10 trials of zebrafish eggs were kept in separate incubators holding temperatures of 27°C and 34°C, mocking the temperature change in our environment. This study was projected to raise zebrafish through the stages of embryo, larvae, and juvenile, reaching the stage where sex can be determined through observation, and ratios were recorded. On day 16, it was concluded that in future studies the food source needs to be small enough for the larvae to digest but not prone to contaminate the water. At this point in the

study, fish were found to have digested each other due to not being able to consume the given food source, but hatching data was still recorded at the beginning of the experiment. The results showed that the 34°C trials hatching rate were nearly a day earlier than the 27°C groups, but by the end of the 5 day hatching period, both groups concluded at the exact same total hatched eggs, averaging 8.7 eggs hatched per dish. These results suggest that warmer temperatures may provoke an unnatural faster hatching pattern in zebrafish species. With this, climate change has additional intended factors than expected through prior research.

Kara Jones, Central Christian School

Inoculating Soilless Growing Media with Mycorrhizae Accelerates Fruit Development in Tomato Plants

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Mycorrhizae are beneficial fungi that colonize the roots and form a symbiotic relationship with plants. They help plants take up more nutrients, which promotes growth and reduces fertilizer runoff. This project was conducted to determine if inoculating soilless media with mycorrhizae could improve 'Tiny Tim' tomato fruit yield and quality. I hypothesized that mycorrhizae treatment would increase fruit size and numbers, accelerate fruit development, and improve fruit quality. Mycorrhizae were incorporated into the media at seedling and again at transplant (n = 12). The control was untreated plants (n = 12). The time to first green tomato was recorded for each plant, and the number of fruits at green, orange or red stages was recorded 106 days after seeding. Total fruit numbers and red fruit weights were determined. Brix (soluble solids) was measured with a refractometer to evaluate fruit quality. The average time for the first green fruit was 70.83 ± 4.0 days for controls and only 66.42 ± 2.54 days for mycorrhizae treated plants. At 106 days, $56.5\% \pm 22.3$ of the fruits on mycorrhizae treated plants were red, while only $28.4\% \pm 23.04$ of the fruits on control plants were red. These differences were significant based on the t-test. Total fruit numbers, red fruit weights, and Brix values were similar in control and mycorrhizae treated plants. While there were no significant differences in fruit size or numbers that could improve yield, the mycorrhizae treatment did accelerate fruiting, which can result in earlier crops in both the field and greenhouse.

Vishwum Kapadia, University School

Correlation of Biofeedback Parameters with the Perception of Relaxation

Oral Presentation: Blackmore Library 115 // 2:00 pm

Biofeedback is a mind-body technique where individuals track their biological functions to decrease stress. There were two objectives in this study: (1) understand the changes in biofeedback measurements, such as changes in respiration rate and skin temperature, during relaxation and (2) correlate these changes to their perceived relaxation, which can help determine if certain biofeedback methods can quantify the extent of relaxation. Eleven volunteers of 55 ± 3 years were relaxed for 11 minutes in a controlled environment using a session from the "Calm" app. Four biofeedback parameters were measured during the relaxation period (skin temperature, heart rate, respiration rate, skin resistance). Post-relaxation, subjects completed a questionnaire to report changes in their perceived relaxation state. Average skin resistance significantly increased from 314.75Ω to 393.33Ω ($p = 0.04$, two-tailed paired t-test). The changes in all other parameters were statistically insignificant, with the average skin temperature increasing from 86.55°F to 88.04°F ($p = 0.24$), heart rate decreasing from 71.90bpm to 71.36bpm ($p = 0.51$), and respiration rate decreasing from 14.82rpm to 14.72rpm ($p = 0.88$). All participants reported some degree of relaxation. However, there was no significant correlation between the parameters and degree of subjective relaxation ($p > 0.05$, Pearson's test). In conclusion, only skin resistance showed a statistically significant change over the relaxation period, coinciding generally with the volunteers' perception of increased relaxation. Since all subjects reported that they felt more relaxed after the session, this study shows that skin resistance can be used to track relaxation.

Emaad Khan, Sylvania Southview High School

Neuroinflammation and Neurodegenerative Diseases

Oral Presentation: Blackmore Library 110 // 4:00 pm

Ischemic stroke is caused by a blood clot in the artery going to the brain, resulting in a breach of homeostasis with an increase in neuroinflammation and cell death brought on by reactive oxygen species. The rise in neuroinflammation is due to increased

reactive oxygen species caused by nitric oxide (previously thought to be protective in ischemic stroke). In this study, the relationship between ischemic stroke and neuroinflammation (and cell viability) was studied and tested by measuring cell viability and nitric oxide levels of normal human microglial cells (HMC-3) and HMC-3 cells treated with lipopolysaccharides (LPS). LPS treated HMC-3 cells recreate ischemic stroke conditions, stimulating a similar inflammatory response as ischemic stroke. Nitric oxide levels were measured using the Griess reagent, while cell viability was measured using an MTT assay. The results show that neuroinflammation is inversely related to cell viability in that LPS treated HMC-3 cells showed significant levels of neuroinflammation with less cell viability. Conversely, the untreated HMC-3 cells showed less significant levels of neuroinflammation with high cell viability. This indicates that neuroinflammation is significant in ischemic stroke; therefore, nitric oxide is a significant factor in ischemic stroke injury. If reduced, it can lead to high cell viability and, therefore, can serve as a potential target for treating ischemic stroke.

Chinmay S. Khare, Ottawa Hills High School

Aqueous Solutions of Sensor Molecules Exhibit Fluorescence Changes in the Presence of Oxidants or Plasma Irradiation

Oral Presentation: Blackmore Library 110 // 3:30 pm

There is an ever-present need for new and improved treatments for cancer. Many treatments are under investigation but an emerging treatment that uses oxidants (substances that have the ability to accept electrons) to kill cancer cells has been recently discovered. However, oxidants in excess can actually cause more damage than good to healthy cells as an unintended consequence. Since antioxidants can nullify the effects of oxidants, I studied the relationship between oxidants and antioxidants at different concentrations and measured their effects on fluorescence in sensor molecules (2',7'-Dichlorodihydrofluorescein). My hypothesis was that adding oxidants to the sensor molecule solution will increase the fluorescence emissions and adding antioxidants will decrease the effect of the oxidants on the sensor molecules. This is because the antioxidants inhibit oxidation of sensor molecules. The oxidant that I used was hydrogen peroxide (H₂O₂) and the antioxidant that I used was ascorbic acid (Vitamin C). First, I labeled and prepared the solutions of H₂O₂, Vitamin C, and sensor molecules at specific concentrations. Second, I mixed the chemicals in the microcentrifuge tubes with a vortex mixer. These solutions were then loaded onto glass capillaries for measurement of the fluorescence signal from the sensors present. Finally, I imaged the capillaries and analyzed the results. Through data analysis I observed that the fluorescence signal from oxidant + sensor molecule solutions is brighter than the solutions with just sensor molecules; and the solutions with antioxidants fluoresce less compared to the solutions with the sensor molecules and oxidants.

Abigail Kittles, Global Impact STEM Academy

Caffeine Amounts in Different Roasts of Coffee Beans

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

The purpose of this project was to see how the amount of caffeine differs in light, medium, and dark roasted coffee beans. It is important to understand how much caffeine is in a cup of coffee and why different roasts contain different amounts of caffeine. This was tested by extracting the caffeine from each roast of bean. Caffeine was extracted from the beans using the solvent, ethyl acetate, which was evaporated off to leave the crude caffeine. The crude caffeine was calculated by subtracting the weight of the empty beaker before, from the weight of the beaker and crude caffeine after the extraction. This process was conducted for five trials for each roast. In conclusion, the light roasted coffee beans had the highest amount of caffeine, then dark roasted, and lastly medium roasted beans.

Alexander Kmetko, University School

Testing Hexagon Supports on an Airfoil to Make it Lighter

Oral Presentation: Troutman Hall 114 // 3:30 pm

This project examines if a sample wing with an airfoil shape filled by hexagons is more mass efficient than a solid filled wing. Aircraft are a large source of greenhouse gas emissions that lead to climate change. One way to reduce these emissions is to decrease the mass of airplanes allowing their engines to do less work. 3D printing is a modern tool used to prototype and develop numerous inventions. Unlike traditional machining 3D printers build up instead of cutting away freeing engineers from

some design limitations. Due to their high ratio of area to perimeter, hexagons use little material and yet still have immense strength, making them ideal to reduce mass. Furthermore, they can tessellate which is required for 3D printing. The wings for this project had the internal structure of plane wings with a single spar and many ribs running perpendicular to it. Previous research has shown that hexagon supports in a wing with this structure are more mass efficient. However, this research also examines if the shape of the wing affects the efficiency of the hexagons. Preliminary data has shown that the trend from previous research holds. Despite the airfoil shape cutting off many of the hexagons, the hexagon supported wings held 35% more force for their mass. A T-Test on these data concluded that the probability they were random was less than 1%. Should these data scale to the size of commercial aircraft, mass could be dramatically reduced.

Rohan Kumar, University School

A Study of EphrinB2 in Global Cellular Tyrosine Phosphorylation in Esophageal Adenocarcinoma

Oral Presentation: Blackmore Library 110 // 3:00 pm

Esophageal adenocarcinoma (EAC) is a highly aggressive cancer with limited treatment options. Ephrin receptor B2 (EphrinB2) tyrosine kinase is overactive during the beginning of EAC development. Studies have shown that EphrinB2 is a regulator of c-MYC. Single-cell RNA studies showed increased EphrinB2 and MYC activity with Barrett's Esophagus. The goal of this study was to see what role EphrinB2 and MYC played in promoting EAC. If EphrinB2 plays a role in the growth of EAC, then it is expected that the western blot lines of it would be more prominent compared to the other proteins due to the fact it would be more present and active. Cancer skin cells were broken down into three trials: 1) control group, the stuffer trial 2) wild-type (WT), the normal proteins, and 3) constitutively active trial, the mutated proteins. A western blot was used to examine the activity of EphrinB2 and other proteins. The activity of each protein was visually examined. Anti-EPHB2 and Anti-V5 blots confirm stable expression of V5-tagged WT and active EPHB2 proteins in SKGT4 cells. The Anti-pY blot shows that active F613D EPHB2 increases global phosphotyrosine levels. It was found that EPHB2 proteins can alter the phosphorylation status of several other cellular proteins, which would severely impair innate cellular processes. Future research should identify the specific proteins impacted by EPHB2 to detect which cellular processes are impaired.

Ally Lewis, Bellbrook High School

The Effects of Menstrual Stigmas and Shame

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

After leading a successful initiative at my school to provide free and accessible menstrual products in every bathroom, I began to ponder how society's so-called "period stigma" is evolving as women across the globe lead similar movements, groups, and events. I delved into a multitude of resources, from scientific journals to documentaries, and found myself immersed in a sea of menstrual activism. Seeing as to how this worldwide menstrual movement is flourishing after decades of strife, I began to theorize that menstrual shame is potentially decreasing. In order to investigate this trend, I explored the effects of menstrual stigma across a broad age range of 4 generations: Baby Boomer Generation, Generation X, Millennial Generation, and Generation Z. With such a large age range, I created a Google Forms questionnaire that was easily accessible to all participants. The questionnaire itself had 3 sections revolving around the participants' implicit encounters with menstrual shame. Each section--Menstrual Education, Menstrual Experiences, and Menstrual Role Models--had 5 questions, resulting in a quick, concise, 15-question survey. Once collected from 80 participants, the data was compared amongst each generation, and 3 trends became ubiquitous. The first trend, found most often, proved that menstrual stigma is indeed decreasing over time. The other trends--that menstrual stigma was not decreasing, and that menstrual stigma decreases with age--provided for a nuanced conclusion that the decrease in menstrual shame, while prevalent, is a complex, layered trend that has many outside factors, and social impediments that sadly prevent its linear decrease and ultimate disappearance.

Kenan Maaieh, Ottawa Hills High School

Effects of TDZD and LKE on the Cognition of Zebrafish Model of Okadaic Acid Induced Alzheimer's Disease

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Alzheimer's disease (AD) is the sixth leading cause of death, and with no current treatments an abundance in patients suffering from AD is inevitable. Most animal models of AD are confined, not being able to mirror the entire pathology of AD. Recently an AD model in zebrafish was produced using okadaic acid (OKA), a protein phosphatase 2A inhibitor. By exposing the zebrafish to OKA, they exhibited most of the neuropathology associated with AD. This produced a model for AD that is time and cost efficient. This study was designed to investigate the neuroprotective properties of 4-benzyl-2-methyl-1, 2, 4-thiadiazolidine-3, 5-dione (TDZD-8) and Lanthionine ketamine 5-ethyl ester (LKE) on the newly developed AD zebrafish models. A total of 25 fish were divided into 5 groups receiving different treatment. There was a negative control group, a group with 100 nM OKA, a group with 100 nM OKA treated with 1 μ M TDZD-8, a group with 100 nM OKA treated with 500 μ M LKE, and a group with 100 nM OKA treated with 1 μ M TDZD-8 and 500 μ M LKE. In past studies, administration of TDZD-8 and LKE separately proved effective, however an impurity of the OKA in this experiment caused a die off, leading to inconclusive results.

Ryan McGinnis, West Geauga High School

Electrolysis of 3D Polylactic Acid (PLA) for Custom Fabrication of Sustainable Electromagnets

Oral Presentation: Troutman Hall 114 // 3:00 pm

Plastic based magnets and circuits are a sustainable and innovative idea to create a more sustainable electronics ecosystem. Additionally, custom fabricated electromagnets could certainly create new types of solenoids at a lower cost than regular electromagnets. Polylactic Acid (PLA) cubes were printed and underwent a multi-stage electrolysis process to coat them in layers of copper and iron. The cubes were tested in etching solutions that varied in concentration and time in the solution. The cubes then underwent electrolysis where voltage, concentration, and time in solution was tested. Each variable was isolated by keeping all other factors constant except the variable in question. The electromagnetic cubes were tested for their magnetic strength at varying voltages, resistance, and efficiency of formation to find the best condition from each category. Once the ideal value from each variable was found, the ideal variables were combined to make the ideal electromagnet. It was found that cubes that were in an electrolytic cell for 80 minutes that consisted of 1M copper sulfate with a voltage of 2V had the lowest resistance and superior ability for other plate layers to form ovetop. The ideal copper cubes were then under iron electrolysis and were tested. The ideal copper cubes were then put in an electrolytic cell of 1M iron chloride for 60 minutes at 1V to form an iron plate around the copper to make the ideal iron-copper cube. The ideal cube was able to produce a magnetic force of 0.0098N at 5V and 1 ampere.

Haasini Mendu, William Mason High School

A Machine Learning Approach for the Early Detection of Parkinson's Disease Based on Acoustic Measures

Oral Presentation: Troutman Hall 112 // 2:30 pm

Parkinson's Disease is the 2nd most common neurodegenerative disorder, affecting more than 200,000 people in the US alone. Caused by damage to the dopamine-producing neurons in the substantia nigra, Parkinson's Disease (PD) is a chronic movement disorder. While the early detection of PD can help slow down symptom progression, current diagnosis methods rely on the subjective observation of motor symptoms that present after significant, irreversible brain damage. Since over 75% of PD patients exhibit voice deficiencies prior to diagnosis, I hypothesized that I could develop a machine learning model that can distinguish between individuals with and without PD using voice samples with an accuracy of 85%. The model was trained on the PD Speech dataset from the UCI ML repository, which contains features extracted from 756 voice samples of individuals with or without PD. The features extracted include key metrics such as fundamental frequency, jitter, and shimmer. In phase 2, I determined the best classification algorithm through training logistic regression, ensemble, KNN, SVM, and naive-Bayes models. The ensemble model composed of multiple decision trees had the highest accuracy of 91% through five-fold cross-validation. The goal of phase 3 was to fine tune the model and identify the most important features for classification from the 753 predictor variables through principal component analysis. The optimized KNN model trained on the selected features achieved the highest accuracy of 95.9%. As voice samples are easily and inexpensively analyzed, this application can potentially make earlier intervention possible before the onset of disabling physical symptoms.

Bryn Morgan, West Geauga High School***A Modern, Software Based Approach to Celestial Navigation***

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

The purpose of this project was to create a system which can, by taking a photograph of the sky, locate the observer based on characteristics of the image taken. This system uses a combination of long exposure cameras to take photos of the night sky, and software to process these images and determine what latitude and longitude on Earth it believes these images came from. The goal was to have this system be as accurate as possible with affordable and accessible consumer-grade hardware, such as a phone or laptop, and to be able to work in imperfect conditions, both of which would greatly increase the practicality of this project in the real world. I went through several iterations and tests while working on this project, such as testing different cameras performance, taking photos in different conditions and light levels, as well as testing with different lenses and stands. The programming aspect of the system also underwent many iterations to allow it to function more accurately, efficiently, and reliably and has the potential to be made even better. This system, unlike traditional location-fixing techniques like the Global Positioning System (GPS), has the benefit of being able to be independent of complex and fragile networks, and with further development, could be accurate enough for some basic navigation, especially over long distances. This project greatly increased my knowledge of astronomy, as well as photography and computer image recognition.

Rayanne Mustapha, The Bounty Collegium***Novel Solutions to Increase Protection in Contact Sports***

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Shin injuries are very common in the game of soccer. Most shin injuries occur as result of displacement of the shin guard. This can impact to an athlete's career. To combat this issue, a novel patent pending shin guard has been developed. This is called the shin guard wrap; this is a shin guard split up into pieces, and placed onto specific areas on a wrap. As the shin guard wraps around your leg, the three segments will interlock into one solid piece. Through the years of developing the Shin Guard Wrap, we have finalized a design that is to be 3D printed using Carbon. Although this design surpasses the look of most shin guards, we want to make sure the protection and comfort is up to par with the previous prototypes. The previous prototypes have already been tested and proven to have 90% less movement as well as 60% less force transmitted through. In this project one will be testing the new and improved Shin Guard Wrap's movement and integrity against the two most popular shin guards. In the market there are two methods of testing a shin guard, the stud impact test, and the blunt impact test. Both testing methods are designed to look at the strength or integrity of the product. Neither of these methods examine the movement of the shin guard. A novel test design was created to test the displacement of the shin guard. It is hypothesized that the shin guard wrap will have less displacement than the most commonly used shin guards, Adidas Ghost Guard, and the Nike Mercurial Lite shin guard.

Dipakshi Pal, Sylvania Northview High School***Detection of Reactive Oxygen Species during Photodynamic Therapy***

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Reactive oxygen species (ROS), also known as oxidants, is often implemented in a variety of therapeutic applications such as in photodynamic therapy, a rising cancer and tumor therapy. Oxidative stress is induced in cancerous cell by the production of reactive oxygen species, ultimately promoting apoptotic cell death. To understand this comprehensive biological response in cells, two experiments were conducted to model the creation and capture the behavior of the production of oxidants in therapy. Utilizing fluorescence microscopy and image analysis through ImageJ, the generation of reactive oxygen species, using photosensitizers and plasma, was measured through the intensity of fluorescence within images taken of the samples in both experiments. From the research, it was concluded that photodynamic therapy can induce a linear increase of ROS production over time, as measured by the intensity of the fluorescence. However, it was also found that both experiments followed the general trend of a saturation curve, being expressions of logarithmic and sigmoidal functions. This data demonstrated revealed that there is an upper experimental threshold limit in the detection of the production reactive oxygen species during photodynamic therapy, which depends on the limited concentration of photosensors in our sample. Thus, indicating that while ROS production can continue to increase linearly through further illumination and irradiation, the increase in ROS can no longer be detected through fluorescence analysis after t seconds given the limited amount of photosensors in the sample.

Deepthisri Paruchuri, Olentangy High School***The Domestic Greywater Treatment by Natural Coagulants***

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Only 1% of the world's water is suitable for drinking. It is said that greywater is the used water collected from clothes washers, bathtubs, showers and sinks. It can be reused to conserve our valuable liquids. The project's objective is to filter greywater after treating with natural coagulants instead of the currently used chemicals that harm plants and the environment. My hypothesis was that if the greywater was treated with the natural material *Strychnos Potatorum*, then the water quality would improve the parameters to make it suitable for irrigation because it is shown to have the best range for hardness, TDS, and PH. The laundry greywater was used and it was mixed with the seeds that were sundried. After that, I used a bubble aerator for half an hour in all the three samples that had *Strychnos Potatorum*, *Moringo Oliefero*, and *Tamarind* seeds. The pH test strips were used to measure the data after filtering the water. However, compared to all natural materials tested, *Strychnos Potatorum* seeds performed the best. Hence, the hypothesis was supported. The greywater treated with *Strychnos Potatorum* seeds had an average pH of 8, hardness of 80, and TDS of 400, all falling within the suitable range for irrigation. The protein content and the amount of proteins in *Strychnos Potatorum* seeds could have played a part in effective flocculation, thus improving the water clarity of the greywater. For a future experiment I would like to test the treated greywater with plants to see the plant growth.

Ramya Rajan, William Mason High School***Identification of Novel Genetic Biomarkers with Prognostic Utility in Lung Adenocarcinoma***

Oral Presentation: Blackmore Library 110 // 2:30 pm

Abstract Lung adenocarcinoma (LUAD) has rates of morbidity and mortality ranking among the highest globally, and due to poor prognosis, the overall survival rate is comparatively lower than other subtypes of lung cancer. Since current diagnostic and prognostic biomarkers significantly lack the efficiency required to develop optimized treatment plans, it is vital to develop a robust biomarker with prognostic utility. The primary purpose of this study was to identify and validate a novel gene biomarker identification method to provide accurate prognostic information based on gene expression in LUAD. The Cancer Genome Atlas (TCGA) LUAD dataset for gene expression was used to extract 150 candidate genes. The analysis of mRNA expression z-scores relative to diploid samples was used to narrow the gene pool, and genes not reaching significant variable (10%) expression were removed. Kaplan Meier regression analysis was carried out to assess prognostic ability of the genes, and 16 potential genetic biomarkers were chosen. Pearson's chi-square test and t-test were used to analyze association between gene expression and clinicopathological characteristics. Using univariate Cox proportional hazard regression analysis, 11 genes showed significant association with overall survival independent of other parameters. Performing ANOVA analysis on stage of LUAD, ANLN, FAM83, TPX2, FOXM1, UBE2T, A2M, and ABCA8 showed significance. Using Kaplan Meier analysis, high risk and low risk groups were differentiated based on median gene expression. In the external cohort dataset, significance level of the 7 genes were all less than 0.05. In contrast to other genes, A2M and ABCA8, showed a lower expression as unfavorable. Cox regression on composite prognostic ability of all 7 genes obtained a significance level $p < 0.01$. To further explore variations, differential gene expression between normal and LUAD datasets was analyzed, revealing significant differences in tumor and normal gene expression. In summary, this study developed a novel seven gene prognostic model which can be used to predict clinical outcomes in LUAD patients. ANLN, FAM83A, TPX2, FOXM1, ABCA8, A2M, and UBE2T were recognized as genes with prognostic utility. These genes showed to be correlated with overall survival, AJCC stage, and other multivariate factors. This effort to develop gene signatures promises to equip clinicians with better information to adopt novel personalized interventions for higher risk patients.

Varun Ramanujam, Dublin Jerome High School***Which Tomato has the Most Active Vitamin C when Cooked?***

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Vitamin C is an essential water soluble nutrient required for the protection against immune deficiencies, cardiovascular disease, prenatal health problems, eye disease, and skin wrinkling. If nothing is done there could be a resurgence of scurvy among a much larger population. Vitamin C is found most commonly in citrus fruits and vegetables, when consumed is carried to tissues but not stored in the human body. Tomatoes have a special place in every major cuisine and are extremely popular with professional and

home gardeners due to the ease with which they can be cultivated. Tomatoes are traditionally grown in soil or hydroponically (in a nutrient solution). Research today does not definitively point to which tomato growing method is better and given the abundance of cooked tomatoes in our diet, this research is focused on identifying the tomato with the most Vitamin C when cooked. Understanding how controlled the hydroponic cultivation methods are, this project's hypothesis is that Hydroponic tomatoes would have more nutrients than tomatoes grown in the soil. Four types of tomatoes, regular, organic, canned and hydroponic were used to make tomato sauce mimicking a recipe that is used at home. A qualitative test using Vit C reagent and a quantitative testing using iodine was used to test which of the 4 tomatoes has the active Vitamin C when cooked. After multiple trials of both test methods, the results did not support the hypothesis.

Anna Catherine Sansalone, Summit Country Day School

Monitoring Montana's Waters: Macroinvertebrate and Water Quality Project

Oral Presentation: Blackmore Library 119 // 2:00 pm

Monitoring Montana's waters is a project that included monitoring the Blackfoot River for biodiversity and water health. The Blackfoot River and its watershed is a relatively pristine body of water that is known for recreation and excellent fishing, however its water was not always so clean. Biological, chemical and physical monitoring of the river are important to maintain its excellent water quality. Macroinvertebrate tests and water quality monitoring were conducted weekly for a span of 8 weeks during the summer of 2021. The macroinvertebrate levels were analyzed using Ohio DNA Stream Quality Assessment Index, EPT, Biotic Index and Beck's Biotic Index. In addition to these tests, examinations of pH, water flow rate and water temperature, nitrate and dissolved oxygen were also conducted to gain physical and chemical knowledge about the river and how it changes throughout the summer season. In this study, the biodiversity of macroinvertebrates was calculated as 2.14 using Shannon's Diversity Index of 2.14. Macroinvertebrate water quality assessments in 3 of the 4 indices found "good" water quality. The level of nitrate ions remained below EPA safe drinking water levels, and the level of dissolved oxygen maintained the healthy water limit throughout the season. This study reaffirms the clean water quality of the Blackfoot River and demonstrates the positive impact of the clean water efforts in Montana.

Javeria Shaikh, Dayton Regional STEM School

Water Filtration

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

The purpose of this experiment was to filter contaminants out of water. My goal was to develop a filter that was cost effective and eco-friendly. I used bamboo tubes as the container for my filter, followed by my four filter materials: sand, a cotton pad so that sand would not filter into the clean water, activated charcoal, and gravel. I used a cap to seal off one end of the filter while still leaving one end open to pour water through. To further concentrate the contaminated pond water I already had, I added a controlled amount of road salt and activated charcoal to separate containers with the pond water before filtering. Then the unconcentrated pond water and both concentrated waters were tested through the filter. I conducted a total of ten trials for each type of water. The data was collected using water testing strips and the data was recorded on graphing paper. It was also recorded that the total cost of both the filters totaled at \$42.4. My results showed that the filter design was able to filter out most, if not all, of the contaminants in the water, including ones with higher contaminant concentration levels. Although this data proved my hypothesis correct, the contaminant levels were not as high as I would have liked to conduct an experiment using my filters.

Jasmine Liou Shone, Hawken Upper School

Characterization of Exercise Intolerance in HFpEF using Machine Learning

Oral Presentation: 10:00 am

Heart failure with preserved ejection fraction (HFpEF), defined as clinical heart failure symptoms with normal left ventricular ejection fraction, constitutes approximately half of all heart failure, and is associated with poor outcomes. Exercise intolerance and dyspnea are common in HFpEF, and mechanisms are poorly understood. Cardiopulmonary exercise testing (CPET) provides important mechanistic insights into the causes of dyspnea and exercise intolerance in these patients and its use is endorsed by

clinical practice guidelines. We sought to characterize dyspnea and understand contributors by in men and women with HFpEF utilizing machine learning approaches. We utilized baseline data acquired as part of a multi-center randomized trial included CPET at baseline in 216 patients with HFpEF. We utilized supervised machine learning models to evaluate clinical, biomarker, and demographic variables associated with impaired exercise tolerance (VO₂ max <80% predicted). We demonstrated that machine learning models using non-CPET derived variables had excellent discrimination (AUROC 0.88 - 0.91). Important features associated with VO₂ included cardiac injury biomarkers (troponins, BNP) and cardiac chamber sizes. The variables associated with VO₂ were different in men vs women, and in obese vs non-obese HFpEF patients. Further studies should investigate machine learning and non-traditional variables/models to evaluate dyspnea.

Avery Simon, Hathaway Brown School

Creating an Autonomous Maze Navigator to Generate Interest in Machine Learning Among Children

Oral Presentation: Troutman Hall 112 // 2:00 pm

The development of visual models using machine learning is fundamental in furthering the interest in artificial intelligence. To create a model easy for children of all ages to understand while also replicating methods used in creating autonomous rovers, a maze design was chosen. A machine learning model was created using the game engine Unity and the ML-Agents plugin simulating a cube avoiding obstacles while trying to reach a designated goal. Reinforcement and curriculum learning, types of machine learning, were used to train the cube. Whenever the cube reached the goal, it gained a point, and whenever it took too long to make a decision or ran into an obstacle, it lost a point, allowing the cube to learn how to reach the reward. The cube was trained in a scenario that took 5,980,000 steps over the course of 24.39 hours. At the end of training, the mean reward over each 20,000-step interval often ranged between 0.508 and 0.667, meaning that the cube reached the reward in a timely manner between 75.40% and 83.35% of the time. When putting the trained brain back into the simulation for an hour, the agent was able to reach the cube 163 times out of 190 episodes, correlating to an 85.79% accuracy rate. As a result of the data collected, it can be stated that the model was able to complete the task a majority of the time, allowing this model to be used in demonstrations to introduce machine learning to children.

Hans Swain, University School

Effect of Excess Dietary Iron on Intestinal Tumorigenesis

Oral Presentation: Blackmore Library 206 // 4:00 pm

Colon cancer is a leading cause of death worldwide. Although essential, excess iron may increase cancer risk. The purpose of this project was to determine the effect of excess dietary iron on intestinal tumorigenesis using immunohistochemistry (IHC) and gene expression data. Previously, Apcmin/+ mice were fed three diets: T1 (Control; 45mg Fe/kg diet), T2 (250mg), and T3 (450mg), for 10 weeks (n = 9/treatment). IHC slides of normal and tumor intestinal tissue were imaged using a Leica DM 6000 microscope (mag-40X+) to determine percent stained cells expressing Ki-67 – a cellular proliferation marker, in 8-10 microvilli (crypt-tip) and equivalent tumor regions/sample. Gene expression data for micro-dissected normal and tumor tissues were analyzed using Mouse Genome 430A 2.0 microarrays. Comparison (t-test) results show significantly different ($p \leq 0.05$) mean Ki-67 stained cells/villi in normal (1.7, 4.4, and 7.2 for T1, T2, and T3) vs. equivalent region tumor tissue (8.4, 16.2, and 20.1 for T1, T2, and T3, respectively). Gene expression and pathway data show that increased iron altered expression of a variety of genes, more so in tumors, and especially genes involved in oxidoreductase (antioxidant) activity, prostaglandin-endoperoxide synthase (COX-2), and glutathione peroxidase, possibly in response to the pro-oxidative, proinflammatory effects of excess iron. Key findings of this study suggest that excess iron accelerates intestinal cell proliferation, especially in tumor tissue, and alters expression of genes involved in antioxidant status and inflammation. This is clinically significant in that long-term, excess iron consumption may lead to greater mortality for those susceptible to intestinal cancer.

Kailey Takaoka, Hathaway Brown School

Epidemiology of Choroid Plexus Tumors in the United States, 2004-2017

Oral Presentation: Blackmore Library 206 // 3:30 pm

Choroid plexus tumors are the most understudied area in neurobiology and limited information is available regarding the biology and best treatment of choroid plexus tumors. For this reason, this study proposes the most up-to-date epidemiological study on choroid plexus tumors utilizing a current and comprehensive dataset from 2004-2017. The age-adjusted incidence rates (AAIRs) and rate ratios (AAIRRs) per 100,000 persons were generated for age, sex, race, histology, with 95% confidence intervals (95% CIs). Additionally, when analyzing treatment methods these variables were stratified by malignancy to locate and target the at-risk population. One of the most noteworthy findings of the study was when stratified by malignancy, among malignant cases there was a much higher incidence rate of pediatric cases in non-malignant tumors. Non-malignant tumors had an AAIR of (0.075 (95% CI: 0.070-0.080) and a count of 866 compared to malignant cases with an AAIR of only (0.024 (95% CI: 0.021-0.027) and a count of 278. We stratified the AAIR and frequency rates by malignancy whereas most studies group them together when analyzing the data. This provides new information because although these tumors are the 'same kind (choroid plexus),' we find that malignancy plays a significant role and the frequencies between the two (malignant & non-malignant) varied. This study is the most current and comprehensive study in the US on these tumors and presents novel information as it aims to identify at risk populations in order to diagnose and treat them before they become a threat.

Emir Tali, William Mason High School

Investigating Dynamic Charging - Wirelessly Charging an Electric Vehicle

Oral Presentation: Troutman Hall 114 // 2:30 pm

This project researched the possibility of using wireless charging on an object in motion, also known as dynamic charging. Wireless charging is typically used to charge a stationary object, like a mobile phone. The project was conducted with electric vehicles in mind, since even though their popularity and reach is increasing, the batteries of electric vehicles continue to impose problems. Dynamic charging could reduce the use of batteries, allowing for smaller batteries on electric vehicles, increased ranges, and reduced costs - all appealing factors to increase the popularity of EVs. It was hypothesized that an electric vehicle could receive power through wireless charging and reduce its reliance on its battery. Experimentation was done using an RC car, wireless transmitters and receivers, and a purpose built circular track. Various combinations of power supply and motor were used as perimeters, and permuted to test 9 different operating conditions. Data collected and later analyzed revealed an increase of 5.1% in efficiency if the vehicle draws power from the battery and wireless charging at the same time, and a theoretical 24.5% increase in efficiency if the vehicle draws power from wireless charging only when possible, and from the battery only if not. The results affirm the feasibility of dynamic charging applications, and open the door towards a more sustainable future through increased adoption of electric vehicles.

Alexander Vincenti, University School

Determining Whether Differentiated Glioma Cells Further Enhance the Bidirectional Interaction between Glioma Stem Cells and Platelets in Glioblastoma Multiforme

Oral Presentation: Blackmore Library 206 // 3:00 pm

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. Despite standard of care including tumor resection followed by chemotherapy and radiation, the median survival of GBM patients is 12-15 months, with a 5-year survival rate of 5.7%. The high mortality rate and treatment resistance in GBM is due to a population of stem-like cells known as glioma stem cells (GSCs). The lab has previously shown that a bidirectional relationship between platelets and GSCs enhances GBM oncogenesis. It was hypothesized that differentiated glioma cells (DGCs) will further enhance the bidirectional interaction between GSCs and platelets in GBM development. This hypothesis was tested by determining if DGCs secrete more or similar levels of thrombin compared to GSCs, followed by determining if DGCs further enhance the proliferation seen upon GSC exposure to platelets. It was found that GBM patients had a ≥ 2 -fold increase in circulating thrombin levels compared to healthy patients ($p < 0.05$). It was also found that DGC secrete ≥ 5 -fold more thrombin than GSCs ($p < 0.001$). However, it was not shown that DGCs further enhance the proliferation of GSCs

caused by platelets. Future studies will determine whether DGCs further enhance platelet activation relative to GSCs alone to determine the role of DGCs secreted thrombin in driving GSC phenotypes.

Eva Wanek, Marion L. Steele High School

An Evolutionary Approach to Inverse Molecular Design for the Discovery of Novel Compounds

Poster Presentation: Capital Center Field House // 10:30 am – 11:50 am

Discovering a drug is a complex and time-consuming process that can cost billions of dollars. Currently, conventional drug discovery methods involve a laborious trial-and-error procedure with no guarantee of success. To address this issue, a hybrid genetic algorithm (HGA) was used to discover drug candidates with desired properties. First, various properties associated with druglikeness were tested on a population of existing molecules (represented as strings). Next, a selection operator chose certain molecules based on a probability distribution. Molecules with a higher fitness value were more likely to be selected. Then, a crossover operator analogous to chromosomal meiosis was used to randomly choose a crossover point on each string. Two 'parent' strings were selected, and data between the parents were swapped. This created a generation of 'offspring,' with each offspring containing information from their parent strings. Additionally, to maintain genetic diversity, certain molecules were subject to a low probability mutation operator analogous to a biological mutation. Lastly, a local search was performed to ensure an optimal solution was found. After just 10 generations, the average fitness value of the molecules was 96.8, with 100 being the highest fitness value obtainable. Ultimately, this study provides insight on how utilizing evolutionary computational methods can be a notable approach in assisting the drug discovery process.

Weining Wang, University School

Investigating Hydrogen Production Enzyme using Gaming GPU

Oral Presentation: Blackmore Library 119 // 4:00 pm

Efficient hydrogen production will facilitate the usage of hydrogen energy. Hydrogenase in green algae is an important enzyme in generating hydrogen. The function of an enzyme is determined by its three-dimensional structure. The structure of hydrogenase suggests residues along the proton transfer pathway are critical for the enzymatic function. The main goal of this project is to identify the structural features coded in the protein sequence that determine the function. The general procedure includes using gaming GPU cards to perform molecular dynamics simulations on four hydrogenase site-directed mutagenesis variants. The root-mean-square deviation (RMSD), radius of gyration, root-mean-square fluctuation (RMSF), principal component analysis (PCA), and Pearson's cross-correlation of each variant were computed and analyzed. Based on the data, global structures, such as the radius of gyration for the whole protein, maintain similarity during 5 nanosecond MD simulations. 2D RMSD and PCA show that variants have different time-dependent dynamics. Using RMSF and Pearson's cross-correlation, the different dynamic features along the proton transfer pathway were identified. This experiment demonstrates the process of establishing the computational procedures to investigate variants of hydrogenase and identify structure and dynamics differences among variants along the proton pathway. It paves way for future expansion to all 11 variants and will facilitate the establishment of structure and functional relationships for residues along the proton transfer pathway.

Elsa Zhou, Indian Hill High School

Effects of the Pandemic on Adverse Event Reports of Cardiovascular Medical Device Failure: Implantable Cardioverter Defibrillators, Coronary Drug-eluting Stents, Percutaneously Delivered Aortic Valves, and Non-allograft Tissue Heart Valves

Oral Presentation: Blackmore Library 110 // 2:00 pm

Regular cardiology practices were interrupted by the COVID-19 pandemic. To better understand the pandemic's effects on cardiology practices, we investigated whether the pandemic affected reporting of cardiovascular medical device failure, by examining whether adverse event reports per week attributed to different cardiovascular devices changed significantly during the pandemic. By using data from FDA's MAUDE database, we compared weekly rates of adverse event reports over the course of three years attributed to each of four devices: 'Implantable Cardioverter Defibrillator (Non-CRT)', 'Coronary Drug-Eluting Stent', 'Aortic Valve, Prosthesis, Percutaneously Delivered', and 'Heart Valve, Non-Allograft Tissue'. Specifically, we looked at trends per week for the adverse events 'Malfunction', 'Injury', and 'Death' for March 2018-March 2019, the pre-pandemic year

of March 2019-March 2020, and the pandemic year March 2020-March 2021. We report a 46% decrease in reported deaths attributed to ICDs, a 27% decrease in reported injuries attributed to coronary DES, a 107% increase in reported deaths and a 45% increase in reported malfunctions attributed to percutaneous aortic valve prostheses, as well as a 27% decrease in reported injuries attributed to non-allograft tissue heart valves (all comparisons pandemic to pre-pandemic). These four cardiovascular medical devices did not homogeneously increase or decrease, suggesting that changing care patterns that differently affected each device were the root of these trends, rather than a broader factor like underreporting which one would expect to affect the devices similarly.

Julia Zhu, Hathaway Brown School

C19orf12 Ablation Caused Mitochondrial Dysfunction and Susceptibility to Ferroptosis in Neuronal Cell Model of MPAN

Oral Presentation: Blackmore Library 119 // 3:30 pm

Mitochondrial membrane protein associated neurodegeneration (MPAN) is a subtype of a group of rare neurological disorders termed Neurodegeneration with Brain Iron Accumulation (NBIA). MPAN is caused by genetic mutations in the C19orf12 gene in an autosomal recessive manner and it is believed that these mutations cause loss of C19orf12 function. It is characterized by massive iron accumulation and neurodegeneration in the brain. In this study, we investigated C19orf12 KO M17 neuroblastoma cells as a cell model for MPAN. The C19orf12 KO M17 cells demonstrated mitochondria fragmentation and dysfunction, as well as iron accumulation and oxidative stress. The C19orf12 KO were also more susceptible to erastin-induced ferroptosis. Pretreatment of DFO, an iron chelator, rescued mitochondrial defects and oxidative stress, and almost completely prevented erastin-induced ferroptosis in the C19orf12 KO M17 cells. These results overall support the notion that iron overload and ferroptosis are critical in the pathogenesis of MPAN.

JUDGING CRITERIA

Oral Presentation Scoring Rubric

The Ohio JSHS recognizes students for original research achievements in the sciences, technology, engineering, or mathematics (STEM). The overall requirement for a paper presentation is that students demonstrate valid investigation and experimentation aimed at discovery of knowledge. The judging criteria and scoring for the Ohio JSHS are presented in the following chart. This scale has a total score of 30 points and serves as the basis for discussions among the judging team. The decisions of the judging team are final.

Judging Criteria:	Fair	Satisfactory	Good	Excellent	Superior
STATEMENT AND IDENTIFICATION OF RESEARCH PROBLEM <ul style="list-style-type: none"> Is the problem clearly stated? Does the presenter demonstrate understanding of existing knowledge about the research problem? 					
SCIENTIFIC THOUGHT, CREATIVITY/ORIGINALITY <ul style="list-style-type: none"> Process skills demonstrated by the student in the solution to the research problem and/or the research design Student demonstrates his or her individual contributions to and understanding of the research problem Level of effort 					
RESEARCH DESIGN, PROCEDURES (MATERIALS & METHODS), RESULTS <p>Science</p> <ul style="list-style-type: none"> Appropriateness of research design and procedures Identification and control of variables Reproducibility <p>Engineering, Computer Science, Technology</p> <ul style="list-style-type: none"> Workable solution that is acceptable to a potential user Recognition of economic feasibility of solution Recognition of relationship between design and end product Tested for performance under conditions of use Results offer an improvement over previous alternatives 					
DISCUSSION/CONCLUSIONS <ul style="list-style-type: none"> Clarity in stating conclusion Logical conclusion that is relevant to the research problem and the results of experimentation or testing Recognizes limits and significance of results Evidence of student’s understanding of the scientific or technological principles Theoretical or practical implications recognized What was learned? 					
SKILL IN COMMUNICATING RESEARCH RESULTS – ORAL PRESENTATION AND WRITTEN REPORT <ul style="list-style-type: none"> Clarity in communicating research results to non-specialized audience and to judges Definition of terms as necessary Appropriate use of audio-visuals Response to questions from audience and judges 					
ACKNOWLEDGMENT OF SOURCES AND MAJOR ASSISTANCE RECEIVED					

Poster Presentation Scoring Rubric

Scoring Category	1 Needs Improvement	2 Acceptable	3 Good	4 Excellent	Score
Appearance/Clarity	The poster is difficult to understand, and/or lacks important information or has excessive and superfluous information.	Organization and appearance of the poster is adequate but could be improved; some sections are significantly deficient of excessive.	Poster is logically organized; use of headings, fonts, etc. is good; some text is overly lengthy and/or contains errors.	Poster is logically organized; effectively uses headings, fonts, colors and white space; text is concise and error-free.	
Abstract	Abstract does not represent student's research or is seriously deficient in terms of accuracy, completeness, clarity, and conciseness.	Abstract is adequate, but has significant deficiency in accuracy, completeness, clarity, and/or conciseness.	Abstract mostly represents student's research, but is slightly deficient in accuracy, completeness, clarity, or conciseness.	Abstract accurately represents the student's research, clearly and accurately summarizes the project and is complete and concise.	
Research Questions	Research questions are unclear and not aligned to the purpose of the study.	Research questions are adequately defined but have significant lack of clarity or alignment with the purpose of the study.	Research questions are well defined but have slight lack of clarity or alignment with the purpose of the study.	Research questions are very clearly defined and well aligned with the purpose of the study.	
Significance of the Research	Explanation of the research problem and its connection to broader issues is largely deficient.	Explanation of the research problem and its connection to broader issues is significantly deficient but has some good points.	Explanation of the research problem and its connection to broader issues has minor deficiencies or is slightly weak.	Student clearly explains the research problem being addressed by the study; clear connections are made to broader issues.	
Research Methods	Methods are not appropriate for the purpose of the study or the description is seriously deficient.	Methods are somewhat appropriate and/or the description has some significant deficiencies.	Methods are largely well chosen and well described but there are some slight deficiencies.	Methods creatively and effectively support the purpose of the study and the description is complete, easy to understand, and concise.	
Conclusions	Unreasonable conclusions are provided and/or no supporting evidence is provided.	Conclusions are appropriate but there are significant deficiencies in evidence or reasoning.	Conclusions are reasonable and supported by evidence but there are slight deficiencies.	All appropriate conclusions are cited and well justified by evidence, reasoning is sound and complete.	
Limitations	Student identification of limitations is largely lacking or deficient.	Student identification and explanation of limitations has significant deficiencies.	Student identification and explanation of limitations has slight deficiencies.	Student clearly and completely identifies and explains all limitations in the study.	
Graphs and/or Tables	Graphs and/or tables are largely deficient with major flaws or omissions.	Graphs and/or tables have significant deficiencies in organization, completeness, or appropriateness.	Graphs and/or tables have slight deficiencies in organization, completeness, accuracy, or appropriateness.	Graphs and/or tables are appropriate, well organized, complete, and accurate.	
Knowledge of Project/Handling of Questions	Student demonstrates little or incorrect knowledge of project when answering questions.	There are significant deficiencies in the student's knowledge of the project when answering questions.	There are slight deficiencies in the student's knowledge of the project when answering questions.	Student is very knowledgeable about the project; effectively handles difficult questions.	
Presence	Student interacts poorly, unprofessionally, or inappropriately with the judge.	Student speaking and interacting with the judge is adequate but lacks some clarity, confidence, and poise.	Student is professional with only slight deficiencies in clarity, confidence, or poise.	Student is professional and displays excellent enthusiasm, confidence, and poise.	
What aspects of the research presentation were done very well?					
What improvements should the student consider?					

AWARDS

Student Awards**1st Place Winner**

\$2,000 College Scholarship sponsored by the United States Army, Navy, and Air Force

Presents research paper at the 2021 National JSHS held April 20-23, 2022

2nd Place Winner

\$1,500 College Scholarship sponsored by the United States Army, Navy, and Air Force

Presents research paper at the 2021 National JSHS held April 20-23, 2022

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 of the 1st place finalists in the National research paper competition
- Six \$8,000 undergraduate tuition scholarships, awarded to each of the 2nd place finalists in the National research paper competition
- Six \$4,000 undergraduate tuition scholarships, awarded to each of the 3rd place finalists 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 2021 National JSHS held April 20-23, 2022

4th Place Winner

Presents poster at the 2021 National JSHS held April 20-23, 2022

5th Place Winner

Presents poster at the 2021 National JSHS held April 20-23, 2022

Congratulations to the 2021 Winners!

1st Place Winner	Kaisal Shah, Hathaway Brown School \$2,000 College Scholarship sponsored by the United States Army, Navy, and Air Force // Presents paper at the 2021 National JSHS
2nd Place Winner	Laalitya Acharya, William Mason High School \$1,500 Ohio JSHS College Scholarship sponsored by the United States Army, Navy, and Air Force // Presents paper at the 2021 National JSHS
3rd Place Winner	Anish Gupta, Sylvania Northview High School \$1000 Ohio JSHS College Scholarship sponsored by the United States Army, Navy, and Air Force // Presents poster as 2021 National JSHS
4th Place Winner	Shruthi Ravichandran, Hathaway Brown High School \$500 Award sponsored by the College of Arts and Sciences, BGSU // Presents poster at the 2021 National JSHS
5th Place Winner	Ivy Wang, Hathaway Brown High School \$250 Award sponsored by the Department of Chemistry, BGSU // Presents poster at the 2021 National JSHS
1st Alternate	Michelle Park, Solon High School \$150 Award sponsored by the College of Education and Human Development, BGSU
2nd Alternate	Jacob Rintamaki, Westlake High School \$100 Award sponsored by the Department of Physics and Astronomy, BGSU
Thomas Alva Edison Award	Carlton Cort, University School \$250 Award sponsored by the Department of Biological Sciences, BGSU

Cumulative Record of the Ohio Student Presenters to the National JSHS

YEAR	NAME	SCHOOL
2021	Kaisal Shah	Hathaway Brown School
	Laalitya Acharya	William Mason High School
2020	Aditi Kumari	Olentangy High School
	Anya Razmi	Hathaway Brown High School
2019	Hannah Doris	Sylvania Northview High School
	Garret Blum	University School
2018	Arukshita Goel	Sylvania Southview High School
	Suraj Srinivasan	Strongsville HS
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
2013	Bluyé DeMessie	William Mason High School
	Peeyush Shrivastava	William Mason High School

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 of \$500 to purchase books, supplies, and equipment for the school. The recent history of award winners is listed below.

2022 Awardee: Crystal Miller, Hathaway Brown School



Dr. Crystal Miller holds a neuroscience degree from Case Western Reserve University and directs the Science Research & Engineering Program (SREP) at Hathaway Brown School where she inspires women to persevere in STEM by facilitating multi-year research opportunities at local institutions for HB Upper School students. Miller keeps up with STEM industries through her involvement in numerous organizations, including the National Consortium of Secondary STEM Schools, American Association for the Advancement of Science, Ohio Academy of Sciences and the National Coalition of Girls' Schools. She recently published a 20-year longitudinal study in the open access journal PLOS ONE reporting that SREP participants credit their experiences in the program with increasing their confidence to pursue STEM fields and educational advancement.

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

Year	Name	School
2021	Crystal Miller	Hathaway Brown School
2020	Jeremy Nixon	Ottawa Hills High School
2019	2019 Kathryn Nelson	Sylvania Northview High School
2018	2018 Sara Laux	University School
2017	Tyler Bruns Rebekah Rice	Gahanna Lincoln High School Gahanna Lincoln High School
2016	Deborah Bogard	Delaware City Schools
2015	Matt Wallschlaeger	Big Walnut High School
2014	Blythe Tipping	Sylvania Southview High School
2013	Abbie Smith	Hilltop Junior High School
2012	Fred Donelson	Gahanna Lincoln High School
2011	Robert Sudomir	Louisville High School

ACKNOWLEDGEMENTS

Program Committee

Rob Ahern

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Kimberly Heym

Andrea M. Karkowski

Leigh Johnson

Terry Lahm

Era McMahon

Tracey Murray

Benjy Pester

Jim Wightman

Greg Winslow

Keynote

Dr. Kathy Sullivan, Scientist, Astronaut, Explorer

Career Panel

Dr. Michael Dennis, Vice President at Chemical Abstract Service

Dr. Leigh Johnson, Chair Mathematics, Computer Science, and Physics, Capital University

Dr. Madison Kommor, Department of Emergency Medicine, Ohio State University Wexner Medical Center

Dr. Tracey Murray, Chair Chemistry and Biochemistry, Capital University

Judges and Volunteers

Zac Ames

Joy Ayinde

Jim Bruner

Annalies Cobin

Janaya Davis

Li Feng

Nathan Gibbs

Rooma Hartman

Sheena Helm

Kimberly Heym

Emily Hutcheson

Leigh Johnson

Stephanie Johnson

John Mersfelder

Christina Mickelson

Isabelle Rodriguez

Jeff Schneider

Mary Schneider

Jon Secaur

Camille Simpson

Ethan Scheck

Alexis Shannon

Nancy Swails

Jennifer Thomas

Terra Williams

Susan Zhao

Contributing Agencies and Organizations

Battelle



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SYMPOSIUM EVALUATION

Please, remember to complete the online evaluation for the 2022 Ohio Junior Science & Humanities Symposium (JSHS). Your input is highly valued and necessary for the continuing success of the Ohio JSHS.

The survey will open on March 12 at 1:00 pm and 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!