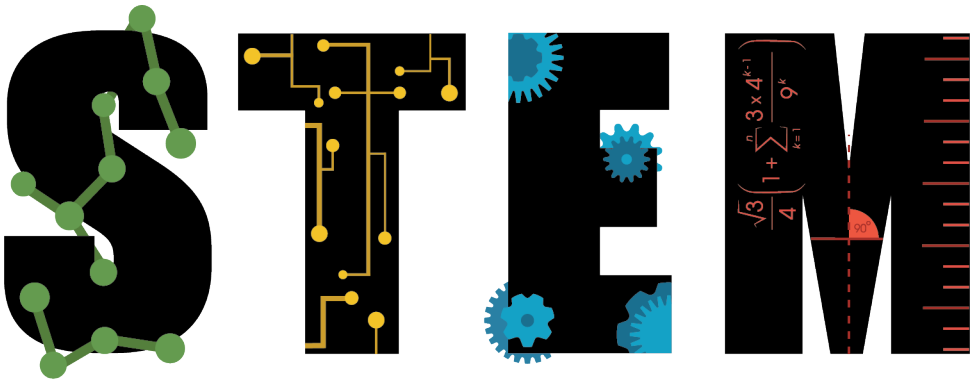
2021 (7th Annual) PASSHE
Student Research Conference in
Science, Technology, Engineering and Mathematics



Pennsylvania's
STATE SYSTEM
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Hosted by

Kutztown University

November 6, 2021

Welcome Message from the Provost

Welcome to Kutztown University and to the 2021 Annual PASSHE STEM Student Research Conference. We are so pleased to have you with us today and to host this important event that showcases the excellence of students of the Pennsylvania State System of Higher Education.

Research has repeatedly indicated that participation in STEM research is of high value for students pursuing undergraduate or graduate degrees. In addition to potentially adding to the body of knowledge about the subject matter, STEM research enhances scientific and mathematical analytic skills, problem solving, critical thinking, planning and follow-through, confidence, and often writing and presentational skills. This work can also contribute significantly to students' future careers, or ongoing educational pursuits.

Within the PASSHE system, student research is encouraged and supported by dedicated faculty who understand the value of such work in the intellectual development of our students. The collaborative spirit of these mentoring faculty members is reflected in the quality of the student work you will see in this conference.

Whether you are attending the conference as a presenter, a supportive friend or family member, a faculty mentor, or as a member of the PASSHE community who values STEM research, I wish you a productive and enlightening conference experience.

Lorin Basden Arnold, Ph.D.
Provost and Vice President for Academic Affairs
Kutztown University

Keynote Speaker: Danielle Moyer

Danielle Moyer is a physical volcanologist who uses a wide range of tools to study active volcanic systems on our Earth to better understand the hazards these systems pose on nearby communities. Her research research during her Ph.D. at Drexel University focused primarily on monitoring volcanic emissions and using Small Unmanned Aerial Vehicles (sUAVs) to take measurements during volcanic eruptions. Her past field areas focused on measuring gas emissions at Yellowstone and taking ash and aerosol measurements at Mt. Sinabung in Indonesia and Villarrica in Chile. She earned her B.S. Geology degree at Kutztown University in 2015 and defended her Ph.D. at Drexel University in 2021.

Title: There and Back Again – Stories of Research, Adventures in the Field, and Remembering One's Roots

Abstract:
A college education, an early idea that was as foreign to me as Latin, was not the path that anyone in my family had taken before me. Coming from a family of military vets, farmers, and proud blue collared workers, I stepped into the world of higher academia wide-eyed and a bit overwhelmed. It was thanks to a dedicated and empathetic group of professors within the Geology department at Kutztown that I started my career in STEM with my feet on the ground running. Through their patient guidance, I went from starry-eyed, rural, kid from Mertztown to a globetrotting volcanologist working on the cutting edge of volcano research. I look forward to sharing the research experiences at Kutztown that helped mold me into the scientist I am today and how they spring boarded me into the world of graduate research. Join me as I take you through stories of misadventures in the field, balancing research with teaching classes of my own, and finding my place among the ranks of researchers working to bring positive change to the world around us.

2021 PASSHE STEM Student Research Conference Program

November 6nd, 2021, Academic Forum (AF)

8:40 – 9:10 am: **Registration and Continental Breakfast** (AF Food Court)

9:10 – 9:20 am: **Opening Remarks** (AF 102)

9:20 – 11:00 am: **First Poster Session** (AF First Floor)

- ***Anthropology*** *(ANH 1)*
- ***Biology*** *(BIO 1-3)*
- ***Chemistry*** *(CHE 1-9)*
- ***Health Science*** *(HEA 1)*
- ***Other STEM Area*** *(OTH1)*

9:20 – 11:00 am: **Oral Presentation Session in Math/CS** (AF 102)

- **The Advantages and Challenges of Being a Female in Computer Science and Information Technology** *Courtney O'Connell*
- **Accelerating Complex Shapes** *Sabrina Vagasky*
- **Digital Images with Encrypted Data Using A Fast Fourier Transform-Based Hash Function** *Matthew Yaswinski*
- **A Simple and Efficient Technique to Generate Bounded Solutions for the Multidimensional Knapsack Problem** *Emre Shively*
- **What You Have Leftover is Perfect: Enumerating the PSR Divisors** *Isaac Reiter*

9:20 – 11:00 am: **Oral Presentation Session in Engineering/Engineering Technology** (AF 103)

- **Autonomous Robotic Arm for Sample Sorting** *Zach Hanlon & Logan Murray*
- **Automation of an Optical Microscope** *Sara Danowski & Tiffany Jolayemi*
- **Coarse Positioning System in Cryogenic Atomic Force Microscope System** *Hiruksha Ranasinghe*
- **Fabrication of Low Temperature Portable Atomic Force Microscope** *Charleigh Rondeau*
- **Approaches in Creating a Cryogenic Atomic Force Microscope** *Crystal Gross, Erica Perry*

11:00 – 11:40 am: **Lunch** (AF Food Court)

11:40 am – 1:00 pm: **Second Poster Session** (AF First Floor)

- **Computer & Information Sciences/Technology** *(CIS1-3)*
- ***Engineering & Engineering Technology*** *(EGR1)*
- **Geosciences** *(GEO 1)*
- ***Physics*** *(PHY1-3)*
- ***Psychology*** *(PSY1-3)*

11:40 am – 1:00 pm: **Oral Presentation Session in Chemistry/GeoSciences/ Statistics** (AF 102)

- **Localizing the Dimerization Element within the DIAP1 Apoptosis Inhibitor Protein** *Coty Emerich*

- **Evaluating the Effectiveness of Washing Strategies on Pesticide Removal from Strawberries and Grapes using QuEChERS and LC-MS/MS Analysis** *Huong Tran*

- **Assessment of Acid Groundwater Seepage from a Confined Disposal Facility (CDF) to an Impaired Salt Marsh on Chincoteague Bay in Greenbackville, Virginia** *Pamela Edris*

- **The Impact of Economic Uncertainties on Stock Market Volatility** *Jadesola Alatishe*

1:05 – 2:05 pm **Keynote Speech** (AF 102)

- **There and Back Again – Stories of Research, Adventures in the Field, and Remembering One's Roots** *Danielle Moyer*

2:05 – 2:15 pm **Awards Session/Closing Remarks** (AF 102)

Oral Presentation Session in Math/CS (9:20 – 11:00, AF 102)

Session Chair: **Dr. Dale Parson (Kutztown University)**

PRESENTATION 1: The Advantages and Challenges of Being a Female in Computer Science and Information Technology
Presenter: **Courtney O'Connell**, Kutztown University
Mentor: **Dr. Lisa Frye**, Kutztown University
Area: Computer & Information Sciences/Technology

Abstract: A stigma exists that women should not be computer scientists as they are "not smart enough" or "too emotional". A brand such as this in a male-dominated field can take a toll on not only the career of the individual but also their mental state. Though there have been many advancements towards removing the stigma, the issue is still present. My academic courses have given me insight to the reality that there are few female computer scientists at Kutztown University. Additionally, my internships have shown me the reality of being a female in the workforce. The combination of my experiences has led me to grow passionate about eliminating the stigma towards women in STEM. My hope is to educate others on the history of female computer scientists, struggles of working in a male-dominated field, and the reality of being a female computer scientist today.

Keywords: *women in STEM, computer science, information technology*

PRESENTATION 2: Accelerating Complex Shapes
Presenter: **Sabrina Vagasky**, Kutztown University
Mentor: **Dr. Dale Parson**, Kutztown University
Area: Computer & Information Sciences/Technology

Abstract: The topic is about accelerating the display of complex 3D geometric shapes. In this project, I build PShapes which is a data type for storing shapes and contains a group of methods to create primitive shapes. When drawing multiple shapes in your processing sketch, for example, if you draw 100 different shapes within the sketch, the sketch will run slowly. This is because the render must compute the geometry for each individual shape even if it is drawing the same shapes. Therefore, I look at what techniques accelerates and slows down the sketch that draws the shapes.

Keywords: *Accelerating Complex Shapes; Processing; PShapes*

PRESENTATION 3: Digital Images with Encrypted Data Using a Fast Fourier Transform-Based Hash Function

Presenter: **Matthew Yaswinski**, East Stroudsburg University
Co-Authors: **Joshua Del Toro**, **Eun-Joo Lee,** East Stroudsburg University
Mentor: **Dr. Eun-Joo Lee**, East Stroudsburg University
Area: Computer & Information Sciences/Technology

Abstract: We created a program that blends cryptographic and steganography techniques. These methods are SWIFFT, DES, and steganography. In this research, SWIFFT, a hash function based on the Fast Fourier Transform (FFT), is used to create a one-way hash function that can only be obtained by having the plaintext. DES is used to produce the ciphertext. The ciphertext and hash function are then placed into an image using spiral techniques and steganography. The combination of these three methods creates a secure and efficient way to transfer data between two users.

Keywords: *Steganography; DES (Data Encryption Standard); Hash Function; SWIFFT; Fast-Fourier Transform*

PRESENTATION 4: A Simple and Efficient Technique to Generate Bounded Solutions for the Multidimensional Knapsack Problem

Presenter: **Emre Shively**, Kutztown University
Co-Author: **Dr. Yun Lu**, Kutztown University
Mentor: **Dr. Yun Lu**, Kutztown University
Area: Computer Science

Abstract: The 0-1 Multidimensional Knapsack Problem (MKP) is a NP-Hard problem that has important applications in business and industry. Approximate solution approaches for the MKP in the literature typically provide no guarantee on how close generated solutions are to the optimum. This article demonstrates how general-purpose integer programming software (Gurobi) is iteratively used to generate solutions for the 270 MKP test problems in Beasley's OR-Library such that, on average, the solutions are guaranteed to be within 0.094% of the optimums and execute in 88 seconds on a standard PC. This methodology, called the simple sequential increasing tolerance (SSIT) matheuristic, uses a sequence of increasing tolerances in Gurobi to generate a solution that is guaranteed to be close to the optimum in a short time. This solution strategy generates bounded solutions in a timely manner without requiring the coding of a problem-specific algorithm. The SSIT results deviated only 0.006% from the optimums.

Keywords: *matheuristic; Gurobi; Multidimensional Knapsack Problem; bounded solutions; simple sequential increasing tolerance matheuristic*

PRESENTATION 5: **What You Have Leftover is Perfect: Enumerating the PSR Divisors**

Presenter: **Isaac Reiter**, Kutztown University
Co-Author: **Dr. Ju Zhou**, Kutztown University
Mentor: **Dr. Ju Zhou**, Kutztown University
Area: Mathematics

Abstract: There are certain positive integers that, when divided into any perfect square, always yield a remainder that is also a perfect square. For example, when 12 is divided into any perfect square, the remainder is 0, 1, 4, or 9. We will refer to these numbers as PSR divisors, PSR standing for Perfect Square Remainder. In this talk, I will begin by demonstrating how to prove that a particular number is a PSR divisor. The proof method is a beautiful application of the fact that every perfect square can be expressed as a sum of consecutive odd numbers. After laying this foundation, I will illuminate the central result of our research. Namely, there are only eight PSR divisors among the positive integers. The proof of this is an excellent example of finding a few “special tricks” that help all the mathematical rigor fall into place.

Keywords: *number theory, perfect square*

Oral Presentation Session in Engineering/Engineering Technology (9:20 – 11:00, AF 103)

Session Chair: **Dr. Sagar Bhandari (Slippery Rock University)**

PRESENTATION 1: Autonomous Robotic Arm for Sample Sorting

Presenters: **Zach Hanlon**, Slippery Rock University
Logan Murray, Slippery Rock University
Mentor: **Dr. Sagar Bhandari**, Slippery Rock University
Area: Engineering & Engineering Technology

Abstract: Robotics are more frequently being implemented into systems to automate tasks, to make jobs easier for humans, and to drastically improve efficiency. The objective for this research project is to create an automated system that efficiently scans and identifies samples of graphene from graphite shards. The objective of the robotic arm is to identify a sample and transport the sample to the stage of an optical microscope. After the microscope is done deciphering if the sample should be kept, the robotic arm will sort the samples into the corresponding piles. We present the design of the arm which is modeled through SolidWorks and then 3D printed. The arm uses 3 stepper motors for X, Y, and Z motion, and a servo motor for the claw mechanism. These motors are controlled by an Arduino microcontroller, and the corresponding code is written through the Arduino Integrated Development Environment (IDE).

Keywords: *Autonomus; Graphene*

PRESENTATION 2: Automation of an Optical Microscope

Presenters: **Sara Danowski**, Slippery Rock University
Tiffany Jolayemi, Slippery Rock University
Co-Author: **Dr. Sagar Bhandari**, Slippery Rock University
Mentor: **Dr. Sagar Bhandari**, Slippery Rock University
Area: Engineering & Engineering Technology

Abstract: Automation is rapidly changing the world making the way we do work smarter and easier. Automating a microscope makes the whole process of analyzing samples quicker, more accurate and more precise. In this talk, we present the design of an automated sample sorting system for Olympus Bx43 microscope. We use stepper motors to turn all of the adjustment knobs including the coarse, fine and light adjustments. These motors will be assorted in a mechanism to the right of the microscope and will communicate with the computer program to adjust and fit the scope camera to see and recognize the sample types encoded. This will allow the process of going through samples, picking one and placing it on the stage, zooming and focusing to the sample, and making decisions about suitable sample to study.

Keywords: *microscope; automation; motor control*

PRESENTATION 3: Coarse Positioning System in Cryogenic Atomic Force Microscope System

Presenter: **Hiruksha Ranasinghe**, Slippery Rock University
Co-Author: **Dr. Sagar Bhandari**, Slippery Rock University
Mentor: **Dr. Sagar Bhandari**, Slippery Rock University
Area: Engineering & Engineering Technology

Abstract: Design of an atomic force microscope (AFM) has its own challenges. One of those challenges is finding a robust coarse positioning system that is precise as well as reliable at low temperatures. It is crucial that an AFM used for imaging quantum systems function in extremely low temperatures and vacuum. We present the design of a coarse positioning system to align the AFM tip relative to the sample. The positioning system uses stepper motor to control three fine-thread screws that push or pull the AFM tip platform relative to the sample. Considerations such as thermal contraction, vibration isolation are made while designing the system.

Keywords: *Coarse; Positioning; System*

PRESENTATION 4: Fabrication of Low Temperature Portable Atomic Force Microscope

Presenter: **Charleigh Rondeau**, Slippery Rock University
Mentor: **Dr. Sagar Bhandari**, Slippery Rock University
Area: Engineering & Engineering Technology

Abstract: Space research and exploration demands a compact tool to analyze soil and particles directly in space. It saves time, money, room, and weight on the rocket. The goal of our present design, with implementation of a cryogenic atomic force microscope (AFM) is to analyze particles and soil on interplanetary surfaces, down to a few nanometers of resolution. We were able to successfully complete a room temperature microscope, to examine and gather feedback from a sample. The design for the mechanics of microscope was made on SolidWorks. The AFM revolves around two main components, a piezotube and cantilever. With the cantilever held fixed, the piezotube, which holds the sample, is actuated to move in three directions with nanometer precision. By utilizing 3D printing, machining, and testing in a cryostat, our low temperature atomic force microscope allows for a creative and inexpensive design in comparison to others.

Keywords: *Atomic force microscope, cryogenics, space*

PRESENTATION 5: Approaches in Creating a Cryogenic Atomic Force Microscope

Presenters: **Crystal Gross**, Slippery Rock University
Erica Perry, Slippery Rock University
Mentor: **Dr. Sagar Bhandari**, Slippery Rock University
Area: Engineering & Engineering Technology

Abstract: There are numerous steps in the process of creating a cryogenic atomic force microscope starting with the idea leading to the finished product. A few stops along the way include the design, software, and calibration of equipment which all present challenges within themselves. We present the crucial use of universal joints in the design of the microscope, the 3-D visualization of microscopy data, and the calibration of a SIM900 Mainframe as a brief look inside the creation and function of a Cryogenic Atomic Force Microscope.

Oral Presentation Session in Chemistry/GeoSciences/Statistics (11:40 – 13:00, AF 102)

Session Chair: **Dr. Adrienne Oakley (Kutztown University)**

PRESENTATION 1: Localizing the Dimerization Element within the DIAP1 Apoptosis Inhibitor Protein

Presenter: **Coty Emerich**, Kutztown University
Co-Author: **Laura Rex**, Kutztown University
Mentor: **Dr. Matthew Junker**, Kutztown University
Area: Chemistry

Abstract: Apoptosis (programmed cell death) is a cellular process found in all animals. This process requires the activity of caspase enzymes which are kept inactive in living cells by IAP (inhibitor of apoptosis) proteins. Effective inhibition of caspases by IAPs may depend on IAPs being able to self-associate into dimers. To determine how IAP dimerization occurs, we are localizing a dimerization element within the Drosophila inhibitor of apoptosis protein 1 (DIAP1).Various fragments of recombinant DIAP1 were expressed in E. coli and purified. The oligomeric state of the fragments was assessed by gel filtration chromatography, in which a column separates proteins by size. Fragments of DIAP1 containing either of two individual BIR domains eluted from the gel filtration column as monomers. However, fragments containing portions of the linker region eluted as dimers, suggesting the linker contains the dimerization element. Analyses are being carried out to refine the location of the dimerization element.

Keywords: *Apoptosis; protein; dimerization*

PRESENTATION 2: Evaluating the Effectiveness of Washing Strategies on Pesticide Removal from Strawberries and Grapes using QuEChERS and LC-MS/MS Analysis

Presenter: **Huong Tran**, Kutztown University
Mentor: **Dr. Julie Palkendo**, Kutztown University
Area: Chemistry

Abstract: Pesticide residues in foods are warned widely to cause negative impacts on human health. Although organic fruits follow stricter agricultural practices, they remain expensive, less accessible, and often with a limited variety. Therefore, a washing method that can be implemented easily in the home on non-organic fruits is a promising solution. This work investigates washing strawberries and grapes with 5 simple solutions including 2 commercially available products. Control and washed samples were processed using a standard QuEChERS extraction method followed by LC-MS/MS analysis that targeted ten pesticides. Results showed that unwashed fruit had significantly higher concentrations of pesticides on the skins or outer layer compared to the flesh. Overall, the majority of pesticides detected on grapes and strawberries were not removed by the employed washing strategies. Cold tap water, Thieves, and Veggie Wash removed fludioxonil from these fruits to varying degrees.

Keywords: *pesticide, fruit, QuEChERS, LC-MS/MS*

PRESENTATION 3: **Assessment of Acid Groundwater Seepage from a Confined Disposal Facility (CDF) to an Impaired Salt Marsh on Chincoteague Bay in Greenbackville, Virginia**

Presenter: **Pamela Edris**, Kutztown University
Mentors: **Dr. Adrienne Oakley**, Kutztown University
Dr. Sean Cornell, Shippensburg University
Area: Geosciences

Abstract: Greenbackville/Franklin City was a booming coastal community in the mid-1800s to early 1900s. A myriad of environmental mistakes including overharvesting, pollution, marsh infilling and mosquito ditching, creation of an oyster shell beach, and dredging for a marina, resulted in catastrophic oyster population decline, degradation of the salt marsh, and eventual downfall of the community. Many of these legacy issues continue to impact the salt marsh. A CDF to contain dredged sediments was constructed in the mid-70s. This catchment accumulates fresh water, providing habitat for an invasive grass, Phragmites australis, and is releasing acidic groundwater into the salt marsh and bay. For this study, we are analyzing soil and groundwater samples from the marsh and CDF for pH, metals, nitrates, DO, salinity, temperature, and elemental composition via SEM. These analyses will be used to inform strategies to neutralize the pH of the CDF runoff and begin to remediate the salt marsh.

Keywords: *marine science, soil and water chemistry, impaired salt marsh, environmental impact*

PRESENTATION 4: **The Impact of Economic Uncertainties on Stock Market Volatility**

Presenter: **Jadesola Alatishe**, Kutztown University
Mentor: **Dr. Necati Tekatli**, Kutztown University
Area: Statistics

Abstract: While uncertainty is a natural inclusion in even the healthiest economic processes, its recent surges have been unpredicted. Equity markets are an informative gauge of the price of policy uncertainty. They reveal investors' assessments of how policy risks impact economic activity into the indefinite future. On a daily basis, stock prices react to news about what governments around the world plan to do or have done. In addition to policy uncertainty, the recent global pandemic has also raised more concerns about stock market volatility across the globe, and Corporate America has since adjusted its business activities to reflect this amplified uncertainty. Building on a theoretical framework and econometric models, with the aid of data software to link stock prices and policy news, this project will demonstrate how stock prices respond to economic policy news.

Keywords: *Stock Market Volatility Index; Economic Uncertainties; Policy News; Econometric Methods; Autoregressive Models; Distributed Lag Model; Causality and Correlation; Macroeconomic Outlook*

First Poster Session (9:20 – 11:00 am, AF Food Court)

Anthropology (Poster ANH 1):

POSTER 1: **Environmental Anthropology**
Presenter: **Rebekah Roux**, Kutztown University
Mentor: **Dr. Kim Shively**, Kutztown University
Area: Anthropology

Abstract: Environmental anthropology is the study of human interactions with their environment. In order to show the importance of this, I interviewed three people who closely interact with their environment. A Native American, an Amish man, and a white-middle class landscaping business owner are three people from vastly different cultural backgrounds who have been taught to view the environment in different ways, even though they live in the same geographic area (upstate New York). With this research I hope to show that people have different views of the environment based on their cultural backgrounds and that they are impacted by the environment in different ways. This will highlight the importance of understanding people's culture while developing environmental conservation plans and policies.

Keywords: *Environmental Anthropology; Native American; Amish; Landscaping*

Biology (Posters BIO 1 – 3):

POSTER 1: **Modelling the Kinematics of Virus Propagation in a Population**
Presenter: **Nicholas Davis**, Kutztown University
Mentor: **Mr. Eric Laub**, Kutztown University
Area: Biology

Abstract: A computer model is developed to describe the propagation of a virus in a population. Parameters such as transmissibility, survival rate, immunity (both natural and vaccine-induced), virus mitigation strategies (mask wearing, physical distancing, etc) along with individuals' mobility within the population are factored into the model. Then by adjusting the parameters of the model to match real-world data, we will attempt to determine the weight of each model parameter and how it contributes to the propagation of a virus.

Keywords: *Computer model, virus, virus propagation, pandemic*

POSTER 2: The Effects of Vaping on Esophageal Keratinocytes
Presenter: **Olivia Medina**, Millersville University
Mentor: **Dr. Laura Ramos**, Millersville University
Area: Biology

Abstract: Although the first electronic cigarette-like device was patented in the 1930s, the electronic nicotine delivery systems (ENDS) seen today did not infiltrate the US market until 2006. Since the 1960s, nicotine use had plummeted, but the invention and popularization of vapes caused its nationwide resurgence. Unlike smoking, however, little is known about the effects of vaping on the human body. Before individuals can weigh the risks associated with vaping, science must come to a consensus on what those risks are. Much of the vaping research today examines the effects on the brain or lungs; however, the esophagus is ignored. We developed an in vitro protocol to assess the effects of different vape chemicals on esophageal keratinocytes. in vitro experiments suggest that esophageal keratinocytes undergo phenotypic and physiological changes when submerged in solutions of media and vaping liquid.

Keywords: *Vaping; physiology; nicotine*

POSTER 3: Effect of Cropping Sequence and Phenology on the Rhizobiome of Hemp and Soy
Presenter: **Alan Snavely**, Millersville University
Mentor: **Dr. Laura Ramos-Sepulveda**, Millersville University
Area: Biology

Abstract: Cannabis sativa is perhaps one of the most infamous plants worldwide – leading to a history of prohibition. Consequently, little is known about the plant. Hemp, the drug free brother of marijuana, is exploding in popularity. With products such as cannabidiol, hemp seeds, natural fiber, Cannabis has many uses. The demand for these products is increasing while our knowledge of its production remains stagnant. The hemp crop is expected to be rotated with other important crops in Pennsylvania like soybeans. It is imperative to understand the microbial composition of the hemp and soy rhizosphere, to determine which taxa the crops have in common at the soil level. The goal of this project is to pioneer the hemp microbiome in PA by finding a core microbiome between hemp and soy, as well as determine the effects of phenology on both crops. Understanding the microbial community is key to successful production of hemp.

Keywords: *microbiome; hemp; agriculture; crop rotation; microbial community; cannabis*

Chemistry (Posters CHE 1 – 9):

POSTER 1: Monitoring Transcription Factor IclR-Effector Binding by Intrinsic Fluorescence

Presenter: **Betel ErKalo**, Millersville University
Co-Author: **Dr. Melissa Mullen-Davis**, Millersville University
Mentor: **Dr. Melissa Mullen-Davis**, Millersville University
Area: Chemistry

Abstract: Antibiotic-resistant bacteria are the cause of deadly infections to millions of people on a yearly basis. These pathogenic bacteria, including Escherichia coli used as a model system in this research, use transcription factors to control cellular response to changing environments and establish infections. The glyoxylate shunt is a significant bacterial pathway regulated by the transcription factor IclR. While the effects of activating and repressing IclR are understood, the specificity of its effector molecules is not. This makes the glyoxylate pathway of interest as a therapeutic target in bacteria as it is not found in human cells. The research focused on studying the structure of IclR and its interaction with its small molecule effectors. IclR's affinity for its small molecule binding partners was evaluated with fluorescence spectroscopy using the intrinsic fluorescence of IclR protein. Binding affinity of IclR with glyoxylate and pyruvate were then calculated and compared to literature values.

Keywords: *IclR; transcription factor; Fluorescence Spectroscopy; Binding Affinity*

POSTER 2: Detection of VOCs in Human Breath using GC-MS

Presenter: **John Ferrari**, Bloomsburg University
Co-Author: **Anand Mahadevan**, Radio Oncologist at Geisinger Hospital
Mentor: **Dr. Daniel McCurry**, Bloomsburg University
Area: Chemistry

Abstract: Human breath contains a rich variety of volatile organic compounds (VOCs) that can be analyzed for specific cancer metabolites. Patient breath samples were captured in Tedlar bags for analysis via GC-MS. Some patients were known to have lung cancer, whereas others served as a control. While all humans emit certain VOCs, increased abundances of isoprene, acetone, and ethanol are common indicators of heavy smokers or cancer biomarkers. A solid phase microextraction (SPME) fiber was used to capture VOCs before injecting them into an Agilent 8890 GC coupled to a triple quadrupole 7000D mass spectrometer. As patients with diagnosed lung cancer go through therapy and forms of recovery, the abundance of the determined VOCs over time can help track the regression of cancer. Ultimately, this data will be used to inform medical doctors about treatment response in patients as not all patients respond positively to the same treatment.

Keywords: *VOC; GC; Cancer; Breath*

POSTER 3: Thiophene-Based Covalent Organic Frameworks with Alkoxy Chains for Improved Crystallinity

Presenter: **Landon Kurtz**, Millersville University
Co-Author: **Soumyodip Banerjee**, Johns Hopkins University
Mentor: **Dr. Kathryn Allen**, Millersville University
Area: Chemistry

Abstract: Covalent Organic Frameworks (COFs) are large, porous, crystalline structures formed by the reversible combination of two or more junctions. COFs have the potential for gas adsorption and catalyzation, which are therefore desirable materials to develop. We used a tetrathiophenyl benzene-based junction and a pyrene-based junction to create COF-1. However, the carbon-carbon bond of the thiophene-benzene freely rotates, which decreases the crystallinity of COF-1. To reduce this free rotation, we then incorporated alkoxy chains at the 1,4 positions of the benzene ring of A. This incorporation increases the tilt of the thiophene propellers relative to the benzene ring, because of electrostatic and steric interactions between alkoxy and thiophene. All monomer units were characterized by 1H NMR, 13C NMR, HRMS, IR, and TLC. COF-1 was characterized by Dr. Thoi's group at John Hopkins University, using X-ray diffraction and testing crystallinity before and after drying the COF under supercritical carbon dioxide.

Keywords: *Covalent Organic Framework; Thiophene; Alkoxy; Butoxy; Dodecyloxy; Pyrene; Free Rotation; Crystallinity*

POSTER 4: Synthesis, Microscopy and Electrochemical Analysis of Mixed-metal Oxide Catalysts for the Oxygen Evolution Reaction

Presenter: **Hannah Laychock**, Kutztown University
Co-Author: **Jenna Kanyak**, Kutztown University
Mentor: **Dr. Darren Achey**, Kutztown University
Area: Chemistry

Abstract: Discovering new and efficient ways to store clean energy is imperative to stop the acceleration of climate change. Water-splitting provides a clean and effective avenue for solar-power storage; however, it is extremely inefficient and requires a catalyst for the reaction to take place.

In this work, mixed metal oxides were synthesized and characterized to determine their effectiveness as catalysts. The mixed metal oxides, Fe2CoO4, Zn2GeO4, and ZnSb2O2, were chosen because of their potential to catalyze the oxygen evolution reaction (OER) portion of water-splitting in a cost-effective way. The products were characterized using multiple characterization methods and then tested electrochemically to establish a better understanding of their viability as catalysts for OER. The research project was then transformed into the topic of an honors thesis.

Keywords: *mixed metal oxides; SEM; Electrochemistry; OER*

POSTER 5: Novel Antibacterial Triscationic Amphiphiles as Medical Grade Disinfectants

Presenter: **Amanda McKee,** Millersville University
Co-Author: **James Clifford**, James Madison University
Mentors: **Dr. Kathryn Allen**, Millersville University
Dr. Kevin Caran, James Madison University
Area: Chemistry

Abstract: An amphiphile is a compound that has both hydrophilic and lipophilic components. As a result, many amphiphiles are soluble in both polar and non-polar solvents. In this project, we synthesize triscationic amphiphiles in an effort to effectively kill pathogenic bacteria. The architecture of our amphiphiles is similar to that of phospholipids in bacterial membranes. This similarity allows the synthetic amphiphiles to incorporate into, and effectively disrupt the packing of molecules in a bacterial membrane. We have prepared several series of triscationic amphiphiles, including those with one or three non-polar tails of varying lengths. We used 1H and 13C NMR spectroscopy, High-Resolution Mass Spectrometry (HRMS), and melting point to confirm the identity and purity of the amphiphiles in this study. We also used several colloidal techniques (conductivity and 1H NMR) to study aggregation of these amphiphiles in water.

Keywords: *amphiphiles; triscationic*

POSTER 6: Creation of Protein Constructs to Localize the Dimerization Element in an Inhibitor of Apoptosis Protein (IAP)

Presenter: **Laura Rex**, Kutztown University
Co-Author: **Coty Emerich**, Kutztown University
Mentor: **Dr. Matthew Junker**, Kutztown University
Area: Chemistry

Abstract: Inhibitor of apoptosis proteins (IAPs) are responsible for the inhibition of caspases, the enzymes that cause apoptosis. Effective inhibition may depend on the IAPs being self-associated as dimers. This is being investigated by determining the location of a putative dimerization element within the Drosophila IAP, called DIAP1. To do this, we are creating different fragments of DIAP1 and testing them for the ability to dimerize by gel filtration chromatography. The method for creating the DIAP1 fragments is the focus of this project. These protein fragments were created using recombinant DNA methods. Recombinant expression techniques were used to produce the DIAP1 protein fragments in E. coli. The fragments were purified, and purification was confirmed using SDS-PAGE. The purified proteins were then assessed for dimerization by gel filtration chromatography. The fragments are showing differences in elution times that provide evidence for a dimerization element in a central region of the DIAP1 protein.

Keywords: *Biochemistry*

POSTER 7: Electrochemical Detection in Microfluidic Devices using Nanostructured Gold

Presenter: **Melissa Sawor**, Bloomsburg University
Mentor: **Dr. Daniel McCurry**, Bloomsburg University
Area: Chemistry

Abstract: Microfluidics are beneficial for limiting sample sizes where the analyte is too expensive or too scarce. Notably, the SARS-CoV-2 pandemic is of significant interest in miniaturized devices due to a potential lower cost per device and increased testing accessibility. The present study uses a completely electrochemical fabrication to create nanoscale gold surfaces. Conductive fluorine-doped tin oxide (FTO) coated glass slides were patterned using traditional etching techniques. Direct metal electrodeposition on the FTO was possible using a modified surface limited redox reaction (SLRR). Master mold geometries fabricated from SU-8 photoresist and subsequent UV-treatment served as a template for producing microfluidic channels in polydimethylsiloxane (PDMS). Once cured, the PDMS was removed from the mold and irreversibly bonded by plasma-treatment to the FTO-coated substrates containing nanostructured Au by SLRR. It is anticipated that such a design will be able to perform sensitive detection in complex, unfiltered media.

Keywords: *Microfluidics; Nanotechnology*

POSTER 8: A New Method to Dimerize Proteins Using Cooperative Binding of HAP1 to DNA

Presenter: **Stephanie Shara,** Kutztown University
Mentor: **Dr. Matthew Junker**, Kutztown University
Area: Chemistry

Abstract: This project is developing a new method for inducing protein dimerization. The binding of two identical protein molecules, or dimerization, is an important process that contributes to a variety of molecular functions in cells. One protein, heme activator protein 1 (HAP1), associates with itself when binding to DNA. HAP1 was fused to the maltose binding protein (MBP) to test if adding DNA could induce dimerization of the fused MBP. The fusion protein was titrated to DNA tagged with the fluorophore fluorescein and the results were measured through fluorescence anisotropy. Titrations were made using DNA with the HAP1 binding sequence as well as DNA lacking the binding sequence. Hill equation analysis showed evidence of cooperative binding with a Hill constant close to 20. Additional experiments are being carried out to standardize this method, which could then be utilized to study dimerization in other proteins.

Keywords: *dimerization, protein, cooperative binding, HAP1, DNA, MBP, methods development*

POSTER 9: Research Experiences of a STEM Student at Kutztown University and 3D Model of the Chemistry Division in Boehm Building

Presenter: **Huong Tran**, Kutztown University
Mentor: **Dr. Lauren Levine**, Kutztown University
Area: Chemistry

Abstract: Research experiences are highly important for undergraduate STEM students who aim to pursue a graduate education. Research projects help develop critical thinking, conduct data analysis, and bolster laboratory skills. This work summarizes two chemistry research projects that I have pursued since my freshman year. The first endeavor focused on determining an effective washing strategy for the removal of pesticide residues from commonly consumed fruits using QuEChERS extraction method and LC-MS/MS analysis. The second one involved constructing a newly designed protein with binding sites for metal and heme. Engineered peptides were tested for novel biochemical and biophysical properties using several biochemistry techniques. To culminate the level of dedication and time I have spent on research, a model of the third floor of Boehm which houses the chemistry department was constructed. This to scale model was made with foam core board and using 3D modeling technology.

Keywords: *Telomere; Cancer; Aging; Molecular; DNA*

Health Science (Posters HEA 1):

POSTER 1: The Impact of Using a Newly Developed Office Ergonomic Device on Select Upper Body Muscular Activity and User Comfort

Presenter: **Marc Turina**, Indiana University
Mentor: **Dr. Wanda Minnick**, Indiana University
Area: Health Science

Abstract: Despite recent advancements in ergonomic office equipment including wireless input devices and work surfaces that convert from sitting to standing work height, many American workers still spend the vast majority of their work days seated. A significant body of research has established that prolonged seated postures at work can contribute to upper body muscular fatigue, employee discomfort and the development of musculoskeletal disorders (MSDs). The purpose of this study will be to evaluate the impact of a novel piece of office equipment on select cervical muscle activity and comfort when subjects utilize the device during periods of office work. The device moves the work surface closer to a seated individual allowing them to recline in their chairs as computer input devices are utilized.The researcher posits that measuring muscular activity and soliciting subject opinions regarding comfort will contribute to the determination of whether the device is of value in preventing MSDs.

Keywords: *Ergonomics; Novel Device; Muscular Activity; User Comfort*

Other STEM Area (Posters OTH 1):

POSTER 1: Work Effort and Perceived Exertion While Wearing Passive Exoskeleton in Industrial Overhead Tasks

Presenter: **Amelia Newton**, Indiana University
Mentor: **Dr. Wanda Minnick**, Indiana University
Area: Other STEM Area

Abstract: This study will determine how workers in the citrus industry interact with a Passive Upper Limb Exoskeleton in relation to the ergonomic effects. There have been numerous studies on PAXEOs in a laboratory setting, with results showing that there are objective and subjective data to support the usefulness of the exoskeleton (Maurice et al, 2019). The real-life application in production has been limited to the automotive industry in Europe. Expanding the analysis of the PAXEO's use in other industries will be critical to its acceptance in application expansion. Previous studies have acknowledged that research on the effectiveness of exoskeletons in the field is needed. It is necessary to determine if the technology will be accepted and received as useful by workers in various industries. Using qualitative and quantitative feedback from the study, a glimpse into worker interaction with the PAXEO in citrus processing, warehousing and transportation will be broadened.

Keywords: *Comfort Ergonomics; Exoskeleton; User Acceptance; Wearable Device*

Computer & Information Sciences/Technology (Posters CIS 1 – 3):

POSTER 1: **An Interdisciplinary Approach to Game Design**
Presenter: **Camille Kester,** Kutztown University
Mentor: **Professor Thiep Pham**, Kutztown University
Area: Computer & Information Sciences/Technology

Abstract: This project combines the curricular experiences of computer science, applied digital arts, and game development to create documentation and playable game components. Here I use game development skills to create an effective story, digital art skills to bring the concepts to life visually, and coding skills to wrap everything up into a distributable application. Documentation fitting of the standards used in today's industry by professional corporations is used to describe my game's concepts. These documents include a project plan, game design documents, art design documents, and technical design documents. I will elaborate on software such as Autodesk Maya and the process of creating 3D models, as well as Visual Studio for code, and Unity for asset consolidation.

Keywords: *computer; science; game; design; art; development; game; digital; coding; application; maya; unity; visual; studio; documentation; 3d; asset; creation*

POSTER 2: **Beginner Bushcraft: An Interactive Illustrated Guide for Outdoor Survival**
Presenter: **Mason Kester,** Kutztown University
Mentors: **Professor Dannell MacIlwraith**, Kutztown University
Professor Elaine Cunfer, Kutztown University
Area: Computer & Information Sciences/Technology

Abstract: The project is the design and code of a web-based guide for outdoor survival and alternative living methods consisting of illustration and detailed descriptions of sustainability practices, both of which help to communicate beginner material. The goal of this project is to create an interactive media which enhances the viewer's learning experience and promotes a clear understanding of educational content more so than what would be possible from reading without immersive visuals for skills that traditionally require hands-on experience. The website's design provides easy access to educational material for those interested in beginning their adventure outdoors but are not sure where to start. Content categories cover four major areas of basic survival skills: building and maintaining an effective shelter, starting a campfire, finding and cooking food, and locating or purifying water. It is an interactive and approachable source of information that builds a foundation for learning more complicated survival techniques.

Keywords: *communication; interactive; UX/UI; code; website; design; survival, sustainability; education*

POSTER 3: Optimizing Processor Utilization by Co-scheduling of Real-Time and Non-Real Time Tasks

Presenter: **Harshavardhi Valmiki,** West Chester University
Mentor: **Dr. Ashik Ahmed Bhuiyan**, West Chester University
Area: Computer & Information Sciences/Technology

Abstract: Scheduling of Mixed-Critical (MC) tasks sequentially and in Parallel has been well explained, especially how a task will schedule and execute based on criticality levels. But while analyzing the details on MC scheduling of parallel tasks, some limitations exist. One challenge among that is the under-utilization of Computing Power (idle cores). Real-time tasks gain high priority due to the stringent requirement of temporal correctness. Recently, the number of cores in a processor has increased, but these cores are often under-utilized due to the characteristics of the real-time parallel tasks. In our work, we are trying to maximize processor cores utilization by considering both real-time and non-real time tasks, where the latter has no strict time bound to meet deadlines. We propose to mitigate the processor under-utilization by executing non-real-time tasks in the background while guaranteeing that overall system performance is not degraded, and all the real-time tasks meet their deadline.

Keywords: *Real-time tasks, Scheduling, non-real-time tasks, Mixed-Critical, processor, cores*

Engineering & Engineering Technology (Poster EGR 1):

POSTER 1: Mechanical Design and Construction of a Multi-Axis Robotic Arm

Presenter: **Logan Murray**, Slippery Rock University
Mentor: **Dr. Sagar Bhandari**, Slippery Rock University
Area: Engineering & Engineering Technology

Abstract: Robotics has risen to the point in which it is seen as the cornerstone within the automation industry. Our research project aims to automate the study graphene through a microscope. For this purpose, a robotic arm is used to transport graphene samples to a microscope. We present the design and implementation of the robotic arm. The robotic arm uses three rotational joints powered by three servo motors that precisely moves a pincer claw into place which is powered by a separate brushless motor. The structure of the arm itself is designed using SolidWorks with a baseplate rotating in the xy-plane, as well as 2 links, one at the baseplate and one at the upper portion of the arm, both controlling the height and forward extension of the claw. Ongoing developments within the robotics field can lead to more automation allowing increased efficiency and accuracy within many different bodies of research.

Keywords: *Robot; Robotic; Arm; Engineering; SolidWorks*

Geosciences (Poster GEO 1):

POSTER 1: **Bringing the D&L to a Phone App**
Presenter: **Daniel Stevens**, Kutztown University
Mentors: **Dr. Laura Sherrod**, Kutztown University
Dr. Steven Schnell, Kutztown University
Area: Geosciences

Abstract: The Delaware and Lehigh National Heritage Corridor is a historical passage that traverses the 165 miles from Wilkes-Barre to Bristol PA. My project was to create a phone app that would showcase different points of interest and trail friendly businesses throughout the metro wilderness that is the corridor. The app uses phone gps data to alert the user to points of interest and trailheads in there proximity. The app also has several virtual tours setup giving the user cultural and historical facts from the palm of their hand.

Keywords: *D&L; Oncell; NPS*

Physics (Posters PHY 1 – 3):

POSTER 1: **Studies of the Cathode Interface of Polymer Solar Cells**
Presenter: **Shae Cole**, Lock Haven University
Co-Author: **Dr. Marian Tzolov**, Lock Haven University
Mentor: **Dr. Marian Tzolov**, Lock Haven University
Area: Physics

Abstract: Solar cells are a renewable source of energy with large potential for reducing harmful emissions. Interest in achieving higher solar cell efficiency via large scale production has led to research of organic photovoltaic materials. Polymer solar cells show promise due to their lightweight and flexibility. We have studied the inverted device architecture which offers higher device stability and reproducibility. We focused our studies on the use of zinc oxide layers for the formation of the cathode interface of the inverted organic solar cells. We have found that lower annealing temperature of the zinc oxide layers results in higher efficiency. Our best solar cells had 9% efficiency. Oxygen plasma treatment of the zinc oxide layers systematically lowers the open circuit voltage from 0.8 V to 0.6 V. We ascribe this to the oxygen saturation of surface bonds of the zinc oxide thus increasing the work function of the layers.

Keywords: *solar cells; organic semiconductors; interfaces*

POSTER 2: Studies of the Anode of Polymer Solar Cells

Presenter: **Marissa Iraca,** Lock Haven University
Co-Author: **Shae Cole**, Lock Haven University
Mentor: **Dr. Marian Tzolov**, Lock Haven University
Area: Physics

Abstract: Solar cells are a renewable source of electrical energy with low impact on the environment. Polymer solar cells are still in development and they are of interest due to their light weight, flexibility, and low cost of production. Published values of 17% efficiency demonstrate their practical potential, while many aspects of their operation need detailed research. Our work investigates the top electrode, the anode of the polymer solar cells. It ensures effective collection of the positive charges, and provides a barrier for the ambient atmosphere. This motivated us to vary the thickness of the interface of MoO3, and to explore additional layer of either aluminum or silver. We show that thickness of MoO3 up to 90 nm still provides satisfactory performance of the solar cells, while it is expected to provide additional device protection. We have evaluated the device performance using current-voltage characterization, optical absorption, and external quantum efficiency spectroscopy.

Keywords: *solar cells; organic semiconductors; interfaces*

POSTER 3: Use of Universal Joints in Cryogenic Atomic Force Microscope System

Presenter: **Erica Perry**, Slippery Rock University
Co-Author: **Dr. Sagar Bhandari**, Slippery Rock University
Mentor: **Dr. Sagar Bhandari**, Slippery Rock University
Area: Physics

Abstract: Designing and building an atomic force microscope comes with many challenges. One of those challenges being finding the right configuration in building this tool and having the microscope function properly, both mechanically and electrically, specifically in extreme temperatures and without gravity. The use of U-joints in the microscope is crucial to the design for functionality purposes. With the overall size of the microscope only being about 10 by 10 centimeters there is limited room mechanics. U-joints allow for transmission of rotary motion while also various relative angles. By using U-joints we can minimize the space occupied by internal mechanisms without losing range of motion due to the closely located pairs of hinges that configure the U-joints.

Keywords: *Universal Joints; Cryogenic Atomic Force Microscope*

Psychology (Posters PSY1 – 2):

POSTER 1: **Predictors of Depressive Disorder Over Time**
Presenter: **Mohamad Khalaifa**, Slippery Rock University
Mentors: **Dr. Jennifer Willford**, Slippery Rock University
Dr. Jana Asher, Slippery Rock University
Area: Psychology

Abstract: Although much research has been done on predictors of depressive disorder, an understanding of predictors of long-term patterns related to depressive disorder still requires research. Using the National Longitudinal Study of Adolescent to Adult Health, this poster will describe how certain life events affect later depressive episodes and long-term depressive disorder. Specifically, the relationship between religious faith, use of alcohol, general physical health, social support system, traumatic events and depression will be elucidated using time series modeling that accounts for covariance in measurements across time.

Keywords: *Depression; Longitudinal Study; Depressive Disorder, Time Series Analysis*

POSTER 2: **Invisible Labour in the Workplace**
Presenter: **Julia Mace**, Kutztown University
Mentors: **Dr. Michele Baranczyk**, Kutztown University
Dr. Kristen Majocha, California University
Area: Psychology

Abstract: Invisible labour is a relatively new topic of interest, despite it occurring long before the term was coined in 1987. Invisible labour is work that occurs behind the scenes, and receives neither recognition or compensation for it's completion. Limited empirical research has been done on invisible labour in the workplace, though existing studies suggest invisible labour is related to higher rates of burnout and dissatisfaction with their job. This project will examine invisible labour as it occurs in the workplace. Additionally this project will propose a general measurement for empirically assessing workplace invisible labour. Creating a universal measure is an essential first step to understanding who does this work, what kind of work is included in invisible labour, and why this labor is invisible in the first place.

Keywords: *invisible labour, invisible work, emotional labour, gender differences, identity management, domestic work*

POSTER 3: **Mindfulness and Attachment Style**

Presenter: **Brooke Ruth**, Shippensburg University
Co-Authors: **Dr. Toru Sato**, Shippensburg University
Dr. Ashley Seibert, Shippensburg University
Mentors: **Dr. Toru Sato**, Shippensburg University
Dr. Ashley Seibert, Shippensburg University
Area: Psychology

Abstract: Past research has revealed significant relationships between mindfulness levels and attachment styles (Stevenson, Emerson, & Millings, 2017). This study examined the relationships between mindfulness and attachment styles using the Mindful Attention Awareness Scale (Brown & Ryan, 2003) and Attachment Style Questionnaire (Feeney, Noller, & Hanrahan, 1994). Although attachment styles are often considered to be categorical, the Attachment Style Questionnaire measures each individual's level of secure, insecure-ambivalent, and insecure-avoidant attachment. A total of 144 undergraduate university students completed a demographics survey, and the two questionnaires mentioned above. Consistent with past research, we hypothesized and found that mindfulness was positively correlated with levels of secure attachment and negatively correlated with levels of both insecure ambivalent and insecure avoidant attachment. Although these relationships have been reported before, this is the first time that these relationships have been reported using the English versions of these two questionnaires (Stevenson, Emerson, & Millings, 2017).

Keywords: *Attachment Style; Mindfulness*

Acknowledgements

Thank you for attending the 2021 (7th) Annual PASSHE Student Research Conference in Science, Technology, Engineering, and Mathematics. We hope you enjoyed your trip to Kutztown University and your conversations with colleagues across the State System.

We would like to thank all the PASSHE student presenters as well as their faculty mentors for making this conference possible. We really appreciate all the faculty coordinators, volunteer faculty judges and session moderators who helped the conference run smoothly.

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Congratulations again to all our presenters! We hope to see you at the next Annual PASSHE Student Research Conference in Science, Technology, Engineering, and Mathematics.

Sincerely,

Conference Organization Committee

Kaoutar El Mounadi, Associate Professor, Biology
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Matthew Junker, Associate Professor, Chemistry - Biochemistry
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