



PennState
Harrisburg





2019 Grand Champions—Bishop Shanahan High School, Archdiocese of Philadelphia, representing Chester County IU 24

Student teams participated in several learning activities at Penn State Harrisburg on May 9, 2019 during The Governor’s STEM Competition 2019.

Penn State Harrisburg hosted the Governor’s STEM Competition in 2019 and provided STEM demonstrations and campus tours for over 200 students, their advisers, and Competition organizers. Students participated in and observed STEM disciplines including: biology/ science, computer science, civil engineering and structural design/ construction engineering technology, electrical engineering/electrical engineering technology, and mechanical engineering/mechanical engineering technology. Some of the activities involved DNA finger- printing, liquid nitrogen demonstrations, overview of survey and geoscience soils, tension lab demonstrations, CNC machining, computing and artificial intelligence hands-on activities, data loggers, motors, and robotic arm demonstrations.

Pennsylvania State Regional Winners

Intermediate Unit	Regional Winners*	Advisor(s)
Intermediate Unit 1	Peters Township High School	Christopher Allen
Pittsburgh - Mt. Oliver Intermediate Unit 2	Pittsburgh Allderdice High School* (Representative)	Matthew Battaglia Devin Pindroh**
Allegheny Intermediate Unit 3	South Fayette High School	James Hausman III
Midwestern Intermediate Unit 4	Neshannock High School	Gregg Micsky
Northwest Tri-County Intermediate Unit 5	Fairview High School	Andrew Burt
Riverview Intermediate Unit 6	Rocky Grove Jr-Sr High School	Bridget Kennedy
Westmoreland Intermediate Unit 7	Eastern Westmoreland Career and Technology Center	Ian Dunlap
Appalachia Intermediate Unit 8	Hollidaysburg Area Senior High School	Benjamin Fogle
Seneca Highlands Intermediate Unit 9	Northern Potter High School* (Representative)	Courtney Straub
Central Intermediate Unit 10	Central Mountain High School	Suzanne Hanna Jim Rogers**
Tuscarora Intermediate Unit 11	Southern Huntingdon County High School* (Representative)	Nicolee Christophel
Lincoln Intermediate Unit 12	Red Lion Area Senior High School	Nathan Barrett
Lancaster-Lebanon Intermediate Unit 13	Garden Spot High School	Joseph Steinmacher
Berks County Intermediate Unit 14	Wilson High School	Beth Levan
Capital Area Intermediate Unit 15	Cedar Cliff High School	Amy Dando
Central Susquehanna Intermediate Unit 16	Midd-West High School	Edward Gunkle Matthew Dietz**
BLaST Intermediate Unit 17	Towanda Area High School	Jonathan Sayre
BLaST Intermediate Unit 17	Loyalsock High School* (Representative)	Bradley Grey

Pennsylvania State Regional Winners continued . . .

Intermediate Unit	Regional Winners*	Advisor(s)
Luzerne Intermediate Unit 18	Tunkhannock Area High School	Andrew Neely Karen Kutish**
Northeastern Educational Intermediate Unit 19	Forest City Regional High School	William Graziano
Colonial Intermediate Unit 20	Monroe Career and Technical Institute	Ross Ruschman
Carbon Lehigh Intermediate Unit 21	Parkland High School	Christopher Gahman
Bucks Intermediate Unit 22	Pennridge High School	Melissa O'Brien Dina Dormer**
Montgomery County Intermediate Unit 23	Pottstown High School	Andrew Bachman
Chester County Intermediate Unit 24	Bishop Shanahan High School	Dr. John Janasik
Delaware County Intermediate Unit 25	Garnet Valley High School* (Representative)	Elizabeth Bish
Philadelphia Intermediate Unit 26	Philadelphia Academy Charter High School	Robert Mottershead
Schuylkill Intermediate Unit 29	North Schuylkill Area High School	Kelly Stone

*This team will represent their intermediate unit.

**Secondary advisor

Project Titles and Descriptions

IU1 School: Peters Township High School Title: The Bee Box



The Bee Box is a device that aims to increase floral resources for bees. As a result, bee colonies will grow, promoting an increase in agricultural production. This 3-D printed box-like device will contain seeds and be equipped with magnets so it can attach to the sides of cars. Additionally, it will have a weighted spinner on the inside which will scoop up seeds and dispense them from the machine when drivers reach 60 mph. When drivers reach highway speed limit, the device will begin to dispense indigenous, airborne seeds into the ecosystem. These seeds will reach areas of unused lands, such as medians and curbs, and grow into flowers that the bees can use for food. We wish to take extraneous land and turn it into a resource that can better Pennsylvania's environment and economy through a flourishing agricultural system. Also, it will increase and support thriving bee colonies in Pennsylvania.

IU2 School: Pittsburgh Allderdice High School Title: Hydroponics and Pittsburgh's Food Apartheid



Exploring Pittsburgh's food apartheid and using low cost, efficient hydroponics systems to combat the local food deserts. With the use of community involvement and local food banks, we plan on creating large scale systems to help feed low income residents. We are also working to design and create small-scale tabletop systems that could be donated to the elderly. In addition, we will provide knowledge for residents to create scalable systems.

IU3 School: South Fayette High School Title: SMARThex



SMARThex, the Simple Medication Adherence Remembrance Tool, an integrated smart-phone application and pill dispenser that ensures users take their medications on time every time, effectively combating medication nonadherence through its simple-to-use controls and multi-layered notification system.

IU4 School: Neshannock Township School District Title: PAUL - Pothole Automated Utility Leveler



In the community around Neshannock Township, a large problem we face everyday is potholes. Our solution to this problem is PAUL, the Pothole Automated Utility Leveler. Our vision is that PAUL will be housed at PENNDOT stations along the highways, and would be synced to an app that all Pennsylvanians can use to report

potholes in their area. After PAUL receives the message from the app, he will leave his charging station and head to the coordinates given to him. Once there, PAUL will use distance and mapping sensors to find the exact pothole and figure out the size and depth of the hole. He will then position himself directly over the center of the hole and release the filler. PAUL uses a non-newtonian, fluid filler (oobleck, which is a mixture of cornstarch and water) to represent the asphalt it would be using in the real world, since asphalt is not practical to use in such a professional presentation setting. Using multiple sensors, PAUL will know when this liquid filler is level with the road, stop the flow of the filler, and move on to his next report. Making the pothole filling process completely autonomous.

IU5 School: Fairview High School
Title: R.I.S.K.



R.I.S.K. (Rapid Injury Screening Kit) will assist in visualizing an individual's vitals as they are evaluated by an athletic trainer. If an injury occurs during an athletic activity, the trainer can take R.I.S.K, strap the device to a leg or arm to begin observing vitals as any injury is diagnosed.

IU6 School: Rocky Grove High School
Title: Roadside Wind Turbines



Our device would produce electricity using wind and solar energy to help farmers irrigate crops in the summer and to heat roads in the winter.

IU7 School: Eastern Westmoreland Career and Technology Center
Title: N4N



N4N is a company based around the principle of harm reduction. Due to the prominence of IV drug use in Westmoreland County and the difficulty regarding the prevention of acquiring illegal IV substances through legislative efforts, a solution pertaining to the side-effects of abuse stands as a viable means of combating aspects of this epidemic. N4N's solution is a hypodermic needle exchange system. Built on the idea of harm reduction, its purpose is to reduce HCV and HIV infection rates in users and provide a proper disposal site for hypodermic needles. The product works as a 1:1 trade - meaning a used needle is disposed of in the top of the machine, and a clean needle is dispensed along with alcohol prep pads. The product is rectangular in shape and constructed entirely out of 1660 aluminum. We contacted many lawmakers and those who were well versed in legislation, as well as medical professionals. These contacts consisted of Professor Elizabeth van Nostrand, Brian Dempsey of the DEA, CRNP Stuart Fisk, SPSHS and Director of the Westmoreland County Drug Overdose Task Force Tim Phillips.

IU8 School: Hollidaysburg Area Senior High School
Title: Roadside Reliance



The light's purpose is to call for a helping hand when someone experiences car troubles or emergency issues. Several areas in rural Pennsylvania have bad service, and with the state's dangerous weather conditions the light can be a life saver. The conventional four-way flashers do not show fellow drivers that you are having trouble. Rather, they assume someone is just pulling off to send a text or discipline naughty children. This light would outline the back window of any car, SUV or truck. If it works, a future improvement would be adding a button onto the side of a steering wheel. A wire would run through the car and will be hooked to both the backlights. When you press the button, the backlights will flash SOS. This will alert other traffic if there is an emergency. Between spotty cell signals, and common bad weather, hazards are prone to happen on Pennsylvania roads and highways. Whether someone has car trouble or runs out of gas, it gives other cars an idea of why they are stopped and if they should provide assistance. roadways, bridges, and underpasses to alert vehicular traffic to high water conditions. This is a real world problem documented and discussed with the Pennsylvania Department of Conservation and Natural Resources at Shawnee State Park. A second smarter State Park feature is the addition of ultrasonic sensor illuminated guide signs at critical intersections for RV campers entering the park at night. It is not uncommon for an RV to make a wrong turn due to small signs and no lighting at night.

IU10 School: Central Mountain High School
Title: Bio-Photovoltaic Cells



Our project is a system of electricity-generating cells that will be used to power a light bulb. My students will be growing cyanobacteria in a series of cells, each with an anode, a cathode, a suitable medium and the cyanobacteria capable of producing electricity.

IU11 School: Southern Huntingdon County HSMS
Title: Plan Bee



Pollinators of the world are declining for many reasons. We are attempting to help the pollination process while the pollinators, honeybees in particular, make a recovery in order to help protect the many benefits pollinators provide.

IU12 School: Red Lion Area Senior High School
Title: UVShield



UVShield is a phone case with an integrated UV sensor. The UV sensor provides real-time data to the user, helping them take appropriate actions to limit sun exposure and skin damage.

IU13 School: Garden Spot High School
Title: Plant Hopper



The project is designed to use a programmable control board to maximize the space that greenhouse owners have to grow plants. The project's shape is inspired by a ferris wheel. Plants are hung around the wheel and will rotate automatically to receive the correct amount of sunlight and water.

IU14 School: Wilson High School
Title: The EcoEco System



The EcoEco System is a bike attachment that tracks the distance travelled during use and communicates that data to our MyEco App, which calculates how much carbon emission is reduced due to the distance covered. After certain levels of activity are reached, rewards intended to promote local businesses — primarily in the form of gift cards and/or coupons — can be achieved. Along with a record of past trips' data and a time-tracking capability, the MyEco App has an accelerometer function as well as an inbuilt GPS to make the biking experience as efficient as possible. Our main incentive is to encourage more bike usage and spark more awareness and implementation regarding carbon emission reduction. Additionally, a second benefit of our product would be the increase in exercise in Pennsylvanians as well as a degradation in obesity and its resulting negative health contributions.

IU15 School: Cedar Cliff High School
Title: LightLine Active Shooter Response System



A gunshot sensor and detection system with automatic locking mechanisms and lights. The sensor constantly detects sound within an environment, but only triggers the event sequence for those with an intensity exceeding 120 decibels, the minimum level of even a suppressed gunshot. The automated locking mechanisms will secure individual regions of the school, isolating an active shooter. At the same time, the automatic lighting system, in the hallways and classrooms, will use red and green lights to direct students away from the shooter and out of the school through a quick, safe, and efficient evacuation route. The red lights direct first responders to the shooter(s).

IU16 School: Midd-West High School
Title: Personal Health Directory (PHD)



The Personal Health Directory (PHD) solution is a fingerprint reader and database used to provide medical information to emergency care providers allowing them to quickly issue safe and effective care to those in need.

IU17 School: Towanda Area High School
Title: The Snow Buggy



An autonomous robotic snow plow designed to map and plow a person's driveway automatically using sensors and a microcontroller to power servo motors.

IU17 School: Loyalsock High School
Title: INHALATION SALVATION



Drug deliverance issues through inhalers in Chronic Obstructive Respiratory Disease (COPD), restrictive diseases, are a common issue to condition exacerbation in many of those affected. In Pennsylvania, there are 960,000 civilians affected by these ventilatory maladies. In 2017, the NCBI reported that 37.3% of COPD victims have at least 1 emergency hospital visit in less than a year due to misinterpretation and overall misuse of prescribed drug therapy via inhalers. In the situation of misuse, not all of the required medication reaches the lungs, which only increases exacerbation. It was also said that this incident was more common within patients of lower education quality to understand the proper use of an inhaler, by nearly 10%. In order to solve this issue, a newly designed inhaler assistance therapeutic, "Inhalation Salvation" was created. In the morphology of a VHC spacer, this therapeutic allows one to easily breathe in all of the desired medication from their inhaler. Techniques of optimal medication into the lungs is also instilled in the device, and this therapeutic is paired through Bluetooth LE with smartphones and watches that allows one to track and send data and quality of inhaler usage to their healthcare providers.

IU18 School: Tunhannock Area High School
Title: Thermadrone 3D



Thermadrone 3D is a process by which we provide a client with all the information necessary to reduce their carbon footprint and greenhouse gas emissions via drones and thermal scanning technologies. Our overall goal is to increase the efficiency rates in homes and businesses by pinpointing areas of thermal loss. By finding these areas of interest, the greenhouse gas emissions from these areas can be decreased, thereby reducing Pennsylvania's carbon footprint.

IU19 School: Forest City Regional
Title: Safe Tone



Our device is in development to sense a cellular phone's bluetooth connection and detect its proximity within a vehicle. If the cell phone is in the driver's hands, an annoying tone is played until the cell reaches appropriate distance from the device, thus discouraging cell phone use while driving and making the road a safer place.

IU20 School: Monroe Career & Technical Institute
Title: Tambuzi



Tambuzi, Swahili for awareness or diagnosis, is a product line designed to help educators, therapists, and parents teach children to recognize the impacts feelings have on their lives. A twist on the 1970's mood ring, Tambuzi products are coated in thermochromatic ink. This ink is sensitive to the small changes in body temperature that are affected by people's emotions. When used in conjunction with our website and counseling techniques, Tambuzi products help people talk about their feelings and become more aware of their own emotions.

IU21 School: Parkland High School **Title: PFAS Filtration System**



Per- and Polyfluoroalkyl Substances (PFAS) pollution is a growing problem in both Pennsylvania and the United States as a whole. We have designed a water filtration system for these contaminants called the "Pef-fect Filter". Our "Pef-fect Filter" is designed to remove PFAS from lakes, rivers, and other freshwater bodies while integrating seamlessly with nature.

IU22 School: Pennridge High School **Title: Driving STEM Forward With Drones**



The Pennridge Nerd Squad worked to design a kit that makes learning STEM skills a reality for all students. Last year our team had the opportunity to compete at the state level and noticed that access to STEM resources varied by district. Our goal this year was to create a project that would help level the playing field. The Nerd Squad decided to design a kit that would allow students to construct their own drone. All materials are provided within the kit itself, and detailed instructions are provided. The kit also features lesson plans that can help teachers lead students through the engineering design process and develop key STEM skills.

IU 23 School: Pottstown High School **Title: Hot Car Death Prevention System**



Sensors detect a child inside a vehicle while checking the temperature inside the car. The system sounds when the driver seat is not buckled and a child is in the seat. Reactively, the system alarm engages when a child is left in the car and the inside temperature rises to dangerous levels.

IU24 School: Bishop Shanahan High School **Title: ELIAS - Emergency Location Indexing Application System**



ELIAS - Emergency Location Indexing Application System was developed to decrease the valuable time spent on locating victims of an emergency. Because ELIAS is a system that can be accessed remotely, it allows individuals to be located in an emergency without the risk factors normally incurred by emergency personnel. Additionally, ELIAS can function using auxiliary power, which allows it to remain useful when primary power sources are compromised. ELIAS uses a high-frequency RFID (Radio Frequency Identification) signal that allows a two way communication system to power and locate passively powered RFID tags. Once the information about the tag location is received, the information is processed using a RFID Reader to show the location on a visual user interface.

IU25 School: Garnet Valley High School **Title: Anti-ATM Skimmer**



The Anti-ATM skimmer proposes to eliminate the use of skimming techniques employed by thieves and criminals throughout Pennsylvania and beyond. Card skimming often occurs at ATMs, gas stations, or anywhere else that accepts credit cards. ATM skimming accounts for over 95% of all losses in ATM machines. In 2018 alone, Florida found over 1000 skimming devices on ATMs. In Philadelphia, police are finding an increasing amount of ATM skimming devices. In the first half of the year, they already discovered 16 devices. This doesn't even include the number of devices not found by the police. In a skimming incident, thieves place fake credit card readers on the ATM. The fake reader then steals anyone's credit card information if they are unfortunate enough to swipe their card on that credit card reader. The Anti-ATM skimmer solves this problem by creating a card reader that is mobile and non-stationary. By allowing the card reader to move about, it prevents any potential criminal from attaching a card skimming device. Unlike many traditional card readers, most of the credit card readers would sit inside the ATM. A revolving door would be placed in front of the credit card reader and that would only open when in use. Once a user starts using the device, the metal door would slide up to reveal the credit card reader, which is programmed to move randomly. The randomization of the credit card reader adds an additional level of security against ATM skimming devices. These security measures ensure that it will provide users with the promise of security and privacy, and will renew people's confidence in using ATMs.

IU26 School: Philadelphia Academy Charter High School **Title: Solar Scrubber**



Philadelphia Academy Charter School's project is a solar powered outdoor air filtration system. The device will have a steel hull, allowing it to be more durable so it can be applied to street corners, playgrounds, school yards, bus stops, rural fields and other polluted areas to disrupt the development of air pollution throughout the atmosphere. The system will be powered by solar panels and will power a battery and an arduino. This will increase the efficiency of the device; by utilizing photovoltaic cells to mobilize the solar panel, it will then track the sun allowing the device to be activated throughout the day. These features allow our device to perform in any environment during all times, so it is able to reach its maximum efficiency and continuously purify the surrounding air.

IU29 School: North Schuylkill Junior/Senior High School **Title: North Schuylkill Salt Dispenser**



Our plan to benefit Pennsylvanians in their everyday life is to add a sprinkler into their yard. However, this is no ordinary sprinkler, this device will dispense a brine onto their sidewalks in order to prevent ice forming overnight in the cold winters. Ice is a major risk factor in the winter, and adding this gadget into a yard will save many

people. Whether you slip on ice or even fall and break something, this can save your pathways. And the great part is, you won't even need to turn it on.

Our intention is to control the sprinkler so it reacts to its environment. A thermometer, a timer, a moisture sensor, whether there is a lot of moisture in the air or it is freezing rain, the moisture detector will be activated and the temperature will be checked. If the temperature is below 32 degrees, it will begin the dispensing process. The brine will travel from a storage box and travel through tubing until it reaches the sprinkler. The sprinkler will dispense the brine for 2 minutes before stopping. The sprinkler will rest for 10 minutes, and continue this process until either moisture levels have fallen or freezing temperatures have disappeared.

We would like to thank the following partners for their commitment to The Governor's STEM Competition 2020:

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Daniel Benedix, Chef
Jamie Good, Chef

Many thanks to our judges who took time out of their daily schedules to participate:

Brittany Anderson, Chemistry Professor
Earl Brown, Retired Math Teacher
Jared Campbell, PaTTAN
Josh Carney, Engineer
Maureen Dunbar, Retired Math Teacher
Ken Gabel, Retired Engineer
Debbie Harrison, Retired Math Teacher
Judy Hawthorn, Civil War Museum
Ian Kanski, INTAG
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Back Cover: Logo designed by Jouseph Hernandez Ruiz, runner up, Harrisburg High School John Harris Campus.

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