E² Energy to Educate℠

As part of our commitment to education, E² Energy to Educate grant awards support projects that are team oriented, hands-on projects with specific results. E² Energy to Educate projects enhance student understanding of the science and technology needed to address energy issues, and reach and inspire students to think differently about energy.

2019 E2 Energy to Educate – Highlights

- **18 projects awarded more than $460,000, reaching more than 19,000 students nationwide**
- Student projects include solar car competitions, fuel cell technology, wind power and learning energy concepts via an interactive gaming platform.

2019 E² Energy to Educate – Awardees

Albany State University
Albany, GA
At least 100-150 middle and high school students will be directly involved to explore the efficient use of solar energy. In this process, students will measure output voltage of a solar panel by orienting the panel at different angles (0 degree, 15 degree, 30 degree, 45 degree, 60 degree and 75 degree) with the ground and facing the sun from 9 am to 4 pm. Output voltage will be recorded with a voltage data logger at 15 minutes intervals. Student will plot output power versus time graph for each angle of orientation and calculate output energy using a calculus approach where student will find the total area under the curve manually. Next, student will measure the output energy of a solar panel employing a sun tracker with the panel. After analysis of all results, student will be able to find an optimum angle of orientation for solar panel operation and will be able to determine percent increase in output energy using a sun tracker. This project will be carried out during the spring and fall semesters with a different cohort of students from the two schools. In the summer, a solar camp will be hosted at Albany State University and all local school students will be invited to participate in the learning activities associated with the project. Additionally, the camp participants will be taken to a nearby solar farm for a field trip to expose the students to real-world application. At the end of the project, to follow-up student learning and engagement, a group of students will be selected from each participating school to demonstrate the project at a local science fair for competition. The Project Director will purchase the required supplies. The expected outcome of the project will be to motivate at least 30% more students towards choosing a solar energy related STEM career.

ASSET Inc. (DBA ASSET STEM Education)
Pittsburgh, PA
Educators and students will investigate the ways in which energy is produced, transformed, and consumed by utilizing the engineering design process to design and build a model smart home. Classrooms will be provided with the Hummingbird Bit Robotics Kit from Birdbrain Technologies to enable students to explore new technologies available to today's home owners.

Activities:
1. Professional Learning - Educators will participate in two consecutive days (12 hours) of Professional Learning. In all of ASSET's professional learning sessions, educators explore content in the same way that their students will: through hands-on exploration and inquiry. Over the course of two days, participants will: * Explore the nature of science through the lens of the production, transformation, and consumption of energy* Learn the fundamentals of the engineering design process and its application as an instructional strategy* Experience robotics by learning to block code* Learn to foster data literacy skills by exploring and analyzing large, publicly available energy scientific data sources* Utilize an instructional process to make

action-oriented decisions around energy efficiency options* Develop a plan of action to implement in the classroom
2. Classroom Implementation - Students will explore the use of energy by:* Analyzing scientific evidence in order to make informed decisions that impact outcomes * Utilizing robotics, block coding, and engineering design process to design and build a model smart home* Investigating a real-world problem-solving experience in order to explore options and make recommendations (For example, students may explore the energy consumption in their school, or design a new building which makes use of clean energy options) * Communicating their findings to the community

Sustainability: The Hummingbird Bit robotics kits are durable and reusable. Participating educators will be able to repeat the program with new student groups, amplifying the impact of the program over time.

Battelle Education

Columbus, OH

Battelle Education (BED) runs an annual statewide design challenge in which thousands of students across Ohio prototype a cross-disciplinary solution to a real-world problem over the course of the school year. The 2019-2020 design challenge will focus on Smart Mobility. This proposed project will focus the 2020-21 Design Challenge on a Constellation Innovation Theme -- Smart Homes.

1: Design challenge PD - Every year, BED offers a full-day PD opportunity to 100 teachers. The PD has two purposes: providing content knowledge on the challenge topic and giving a crash course on design challenge implementation in the classroom. For this proposed project, this existing PD will expand by 50% in the 2020-21 program cycle to serve 150 teachers.

2: Rural Ohio PD Design Challenge participants should be representative of statewide demographics. This was true for last year's challenge -- those demographics are projected in the target population section below. We see outreach to rural Ohio as an area for us to improve, offering additional support to students and teachers who would otherwise lack access to innovative STEM education. BED has experience in offering rural-focused STEM PD programs, mixing online and in-person learning. We propose designing a new PD experience, specifically for rural outreach, that would include more intensive design thinking training and provide stipends to reimburse teacher travel costs. An additional 50 teachers will receive this rural outreach PD in the 2020-21 program cycle.

While students and teachers are at Battelle for the statewide showcase, we will conduct focus groups with students and teachers to gather qualitative feedback on program implementation, support, and student outcomes. We will also develop a post-challenge survey for all students and teachers including those who do not attend the showcase. This data will allow BED to 1) target future PD efforts to expand program participation and 2) implement changes to improve student and teacher experiences.

Carnegie Mellon University

Pittsburgh, PA

Carnegie Mellon Racing is a student engineering team at Carnegie Mellon University that participates in the Formula SAE Electric competitions hosted by the Society of Automotive Engineering (SAE). The team has a long legacy as an internal combustion team and switched to an electric vehicle six years ago. As one of the first university teams in the United States to make this change, the team pioneers electric racecar technology. The team is currently creating an all-electric, formula-style vehicle to compete in the summer of 2020 in the international field. Formula SAE promotes excellence in engineering as it challenges students to involve themselves with all aspects of the automotive industry beyond just engineering design. They are expected to understand the car not only from a research and manufacturing perspective, but also from a business, marketing, and financial perspective. Formula SAE plays an incredibly important role in the education and experience of our members, who cite being a part of Carnegie Mellon Racing as a key facet in their development as engineers and leaders.

Clarkson University

Potsdam, NY

Constellation funding will allow us to expand our current program (https://sites.clarkson.edu/foodwaste/) to engage over 1,000 K-12 students in a district-wide FW collection system at Canton Central School (CCS).

Trained Clarkson (CU) students will teach classroom activities and mentor K-12 students, with visits to the middle school (MS) and high school (HS) cafeterias and to a new program in the elementary school (ES) cafeteria. Teacher workshops will promote regional expertise. Phase 2 will focus on institutionalization to ensure program sustainability. We will take advantage of the enthusiasm surrounding the FW separation program and focus on identifying a sustainable waste treatment source. We will leverage our partnership with Cornell Cooperative Extension (CCE) and CCS to conduct the following tasks:1. Jan-March 2020. CU students and CCE educator develop and deliver 2 interactive learning modules: on waste disposal and RR (ES, MS) and on AD for HS chemistry. Jan-May 2020. FW collection continues in HS, MS, and ES cafeterias. CU and MS Green Team students will supervise ES rollout in January. CU students transport collection bins to the CCE Farm AD system, then clean and return to CCS. 3. Jan-March 2020. CU Mathematics faculty will challenge students to calculate savings from the FW separation program, relative to handling/delivery costs. CU students will mentor MS Green Team to calculate and present results to demonstrate feasibility.4. Jan-April, Sept-Oct 2020. CU students and CCE educators will visit each cafeteria monthly to coach students about proper FW separation practices.5. March 2020. A teacher workshop modeled on last year's successful Constellation-funded workshop will provide teachers the opportunity to learn about RR, with new classroom-ready teaching modules on RR and AD.6. Spring, Fall 2020. Field trips for participating student classes (~300 K-12 and CU students) to study CCE's small farm digester, CU's FW digester, and a large AD system. 7. Spring, Fall 2020. CU students create and administer online survey to the CU community, gauging awareness of the campus food digester. 8. Spring, Fall 2020. Dissemination occurs throughout the funding period.

Coppin State University Development Foundation Inc.

Baltimore, MD

Through this Constellation Energy to Educate grant, your company will engage over 250 STEM youths (ages 11-24 years) in Baltimore and its vicinities. Our faculty and students will enliven, research, and inspire others to the possibilities of a STEM career within the energy sector, and focus on the Use of Nanoparticles for the Enhancement of Dye Sensitized Solar Cell (DSSC) Efficiency. About 250 middle and high school students drawn from Coppin Academy (CA), Atholton High School, Al-Rahmah (AR), Bluford Drew Jamison STEM Academy (BDJ) and Centennial High School will be involved in the design and fabrication of nanoparticles modified dye sensitized solar cells. The process will include the synthesis of gold and silver nanoparticles, the characterization of the same and their application in dye sensitized solar cell. Students will synthesize silver and gold nanoparticles and characterize them using several analytical and microscopic techniques such as Transmission Electron Microscopy, Scanning Electron Microscopy, Dynamic light scattering, and UV-Vis spectroscopy. Student will prepare nanoparticle fused titanium dioxide paste and spin coat them on conductive glass slides for the fabrication of the photoanode. Photocathode will be prepared in the similar manner like the photoande but the conductive glass in this case will be coated colloidal graphite. The two conductive slides will be brought together to form the DSSC. Students will measure the current and voltages characteristics of the fabricated solar cell devices and evaluate the effect on the gold and silver nanoparticles on the efficiency of dye sensitized solar cells. The students will be directed and mentored by five faculty and five staff scientists. Present their findings at STEM DAY, symposium and conferences including the science fair competition, Energypath conference and ACS regional and national conferences.

Georgia Tech Foundation

Atlanta, GA

6,000 students in 25 counties in Georgia participate in K-12 InVenture Prize, receiving a specialized STEAM curriculum focused on cultivating problem-solving skills, the invention process, and entrepreneurship. The students select an idea and pitch their final projects in a competition format. The E2 Energy to Educate grant will foster solar energy and sustainability interest in K-12 InVenture Prize's project selection via a traveling solar car curriculum which includes kits for hands-on assembly of a car, team competition, and activities and games to promote sustainability and solar/renewable energy education. Student teams compete within their individual schools before advancing to the State Finals held at Georgia Tech. At State Finals, students will further compete and will also have an opportunity to participate in hands-on solar projects and games funded by the E2 Energy to Educate Grant. During State Finals, teams receive project feedback from not only Georgia Tech faculty, but also industry experts. On this K-12 InVenture Prize State Final day, students also have the opportunity to participate in STEAM activities and workshops. We propose debuting a hands-on solar car activity for middle and high school students attending K-12 InVenture Prize State Finals. In teams, students will be given a solar car kit which they will be able to put together themselves and later race against

other teams. While putting together their solar cars, students will be given activities and curriculum focused on explaining the concepts of solar cells and renewable energy sources. After state finals, the solar car kits and their corresponding curriculum will travel to different schools in Georgia to give other students the opportunity to learn about sustainability and solar/renewable energy in a fun, hands-on way. We believe the curriculum will spark interest in more energy related projects selected by the students. Our Exelon traveling solar car kits and curriculum will also be used as an activity during K-12 InVenture Prize summer camp held on the Georgia Tech campus for middle school students. Lastly, we also propose to use the funds to provide an energy saving/environmentally friendly award at State Finals. We will award the team whose project pitch embodies helping the environment and clean energy.

Joliet Junior College Foundation

Joliet, IL

Working with the low-income middle schools within the Joliet Junior College district, JJC will provide an educational opportunity for female students to learn about solar and hydro energy, engineering skills, learning to work in teams, and critical thinking/problem-solving skills. Activities will take place through the choice of three workshops and are purposefully designed to educate in a fun learning environment. Workshops will be three-days long and will be held throughout the year. In a world where renewable energy plays a major role in our future, educating students about alternative energy sources at a young age is important. Each of the workshops will introduce the idea of energy, students learn basic physics theories that they can put into practice. Hands-on activities help students identify types of energy in their surroundings and enhance their understanding of energy. Once the students have an awareness of types of energy, the workshop will move the focus to sustainable energy, specifically solar and hydro. Students will have the opportunity to design, build, and test a solar-powered and/or hydro cell-powered vehicle, and to present their final project at the end of the workshop. Working in teams, students will strengthen their critical-thinking and creative problem-solving skills and reflect on their entry's performance and what they could do to improve it. Upon completion of the program, students will also compete in a cooperative-learning environment to see which design was the most successful. Solar Car Workshop: Using kits, students will design and build a model car that demonstrates solar energy, photovoltaics, velocity, force, and motion. Hydrocar Fuel Cell Workshop: For the students who wish to continue their education and take their STEM learning to the next level, JJC is adding Hydrocar Fuel Cell Car kits in a second workshop. Wind Turbine Workshop: A new course was added to the series for students to continue mastering STEM skills. In this advanced course, students learn how to make the nose cones for wind turbines using computerized software and 3D printing in the MakerLab.

Kean University Foundation

Union, NJ

With the Constellation's E2 grant, Kean University has established an outreach program offering renewable energy workshops for high school students and educators primarily from underprivileged communities in New Jersey. These workshops cover many aspects of renewable energy including energy generation facilities, energy measurements, carbon footprints, and environmental impact assessments. In addition, the workshops rely entirely on hands-on activities, which have been demonstrated to be the best method of encouraging students to pursue studies and improve literacy. The energy program currently can provide five workshop options to participants as follows: 1.Solar cells workshop: A 15-minute lecture will provide an explanation regarding PV cells including their structure, mechanism, and applications in homes and in communities. Then the students will be divided into groups to perform hands-on activities with solar energy lab kits. 2. Fuel cell workshop: A lecture is also provided at first to introduce the basics of fuel cells and their applications for different purposes. The hands-on activities will be based on the Horizon's Renewable Energy Science Education Kit which includes connecting a solar panel to a fuel cell to generate hydrogen and using fuel cells to power an LED light module, a fan and a wheel. 3. Building energy use workshop: The workshop will concentrate on energy consumption, efficiency, and the carbon footprints of buildings. Lab activities will include measuring energy consumption, calculating energy efficiency, identifying opportunities to conserve energy, and promoting renewable energy. The lab will also teach the students how to estimate carbon footprints of residential buildings. 4. Life cycle assessment workshop: This workshop will be focused on introducing life cycle assessment (LCA). Students will discuss environmental impacts of renewable energy in the workshop which could raise critical thinking in this field. 5. Wind turbine workshop: This workshop will introduce various applications of wind power, configuration, mechanism of wind turbines, wind turbine

efficiency, and design. Students will use the wind turbine lab kits to examine how the turbine efficiency changes with the shapes of blades.

Legends of Learning

Washington, DC

In past years through this grant, Constellation has funded the development of curriculum aligned games that teach about solar power, renewable energy and energy storage and provided those games for free throughout the Exelon footprint from Maryland to Pennsylvania to Illinois. For this year, we are proposing to host a game design contest. Students will be provided with a set of information/curriculum developed by Legends (happy to have Constellation participate) about challenges faced by modern power grids and how new technologies (solar, energy storage, wind power), existing technology (e.g. Nuclear and the grid technology itself) and future technology can solve those problems. Student groups (by class) will be given 30 days to submit an idea for a game design (within parameters provided for the content) that will help best teach these concepts. The winning classes (3 of them) will then be partnered with professional game developers to turn their game ideas into reality. The winners will be spaced out geographically as best as possible. As the games are being made, students will interact with developers to make the games. When the games are finished, they will be published on the Legends of Learning platform and available for free for the over 2,000,000 monthly active users of the platform. One grand winner will be invited to send a few representatives to Baltimore to attend the 2019 Game Based Learning Summit and speak to leading curriculum thought leaders and gaming companies from around the United States about their experience and Constellation will be the main sponsor of that experience (no additional funding will be required for that). Legends would target the student participation in the contest to students in the Exelon utility footprint with an emphasis on Title I and other underserved areas with a specific emphasis on minority women.

Milwaukee Board of School Directors DBA Milwaukee Public Schools

Milwaukee, WI

Frontiers of Innovation and Application in Fusion Studies developed from the 2019 Project Lead the Way (PLTW) competition. The goal is to put affordable, portable, and renewable energy sources on a barge using fusion as an energy source. Making the fusion barge a reality and using fusion as a clean energy, has become a priority, especially since hurricane Dorian's destruction of the Bahamas. The need for humanitarian aid during disasters reaches beyond any financial gains that could ever be achieved. This year's team plans to develop a fusion powered barge that would fill this void. The energy produced by the fusion barge, the USS Redcat, would power generators and electric cars, provide clean water, grow and produce healthy food through gardening and hydroponics, distribute medical provisions, transport critical cleaning and building materials, as well as supplying any necessary personnel to help the rebuilding efforts begin as soon as possible. Bay View High School (BVHS) has a Fusion Team, that plans and develops Fusion Fest 4.0 (Clean Energy), held in November. They prepare announcements, organize the event and work with the Digital Arts class to develop a flyer. The purpose of the fest is to make fusion a reality by sharing what has been learned about fusion with the neighboring BV elementary schools, community and business partners. The event will kick off with a keynote speaker followed by student presentations. Local and national industry leaders question and provide feedback to the students. The Milwaukee Haz-Mat Team will demonstrate how various wavelengths of light can serve a community. After Fusion Fest, using feedback from industry leaders, students will revisit the research and continue to develop the projects in preparation for the STEAM Showcase. In January, students present the updated projects at the STEAM Showcase. The student's work throughout the year prepares them for the national PLTW competition held in spring. It gives students the opportunity to address a problem and design a solution. The competition is designed to recognize and reward outstanding student projects and to highlight the importance of engineering design that solves real-world problems.

Rochester Institute of Technology

Rochester, NY

The secret to switching the global energy system entirely to renewables may lie in the universe's most abundant substance, hydrogen. Hydrogen is a "Clean" energy source because only one product, water, is formed during energy generation. We purpose to further expand and develop our High School Education Program about Renewable/Clean Energy and Electricity Generation Using Fuel Cells, which we started in 2008 by publishing the first edition of our textbook entitled "Introduction to Hydrogen Technology" and our textbook "Clean Energy Hydrogen/Fuel Cells Laboratory Manual' in 2016, by offering across New York State

(NYS) face-to-face and online training sessions for High School Teachers and students. The program will now partner with our former High School teachers, who participated in our previous training sessions, to encourage them to bring their students in groups onto RIT's campus to learn about this education throughout the year and not just during Summer. To attract High School students, partnerships are also formed with the: (1) American Chemical Society (ACS) -- SEED program for economically disadvantaged students; (2) Rochester Youth Climate Leaders (www.rycl.org), who hold an Annual Youth Climate Summit at the Rochester Museum & Science Center and (3) RIT's well established Summer Math Institute (SMI) High School Teachers' Workshops for math and science teachers: https://www.rit.edu/science/summer-math-institute-workshop. Our on-campus workshops will include presentations and discussions, hands-on experience using fuel cells, and tours of the Golisano Institute for Sustainability focusing on demonstrations in the Fuel Cell Test Bed. The training sessions for NYS High School Teachers will include: online webinars and one-day lab experimental demonstration at RIT. To enhance and advertise the program throughout NYS, presentations of this program will be made at the 124th Annual Conference for Science Teachers Association of NYS (STANYS) held in Rochester, NY, on Nov 2-4, 2019, and at NYS Regional Meetings of the American Chemical Society (ACS) where names and email addresses of potential teachers will be collected.

Sistema Universitario Ana G. Mendez, Inc.

Gurabo, PR

This project will focus on high school students interested in pursuing STEM careers. The Puerto Rico Energy Center (PREC) of the School of Engineering (SoE) is dedicated to developing innovative energy and clean technologies, while supporting entrepreneurial projects and commercialization. Energy is a challenge for Puerto Rico, from hurricanes to high energy costs, the efficient and intelligent use is of greater importance for the next generation of engineering and science students. As energy costs keep increasing (up to $0.22/kW-hr, more than twice the average of the energy cost in the US), the greater the challenge to learn, develop and implement efficient energy strategies and technologies. By having students learn the concepts from an early stage they will be better prepared to find innovative solutions. An intensive resilient energy summer experience for high school students, with two weeks of hands-on project-based sessions. The proposed scheme defines two (2), 2-week cycles. Each cycle is designed to impact fifty (50) high school students divided into two groups (1 and 2) and includes the following three subjects:

1. Energy management including energy consumption monitoring.
2. Renewable Energy including solar and wind energy
3. Energy transportation.

The topics to be covered and the project are summarized as follows:
Electrification - Energy Transportation: different types of transportation topics in energy including electrical cars, hybrid cars, electrical car grid integration, batteries and alternate fuel vehicles (natural gas, fuel cells, biofuels) Activity: build a simple spring powered vehicle and fuel cell vehicle. Smart Home - Energy Management: easy to perform energy assessment tools and strategies including efficient on-site generation, illumination systems, HVAC, an equipment use. Activity: Energy assessment of a house. Clean Energy - Wind Energy: Learn basic concepts of wind energy and airfoil design using QBlade. Activities: Design an airfoil and construct a model with a 3D printer; construct and test a small-scale wind turbine. Solar Energy: Learn basic concepts of solar energy, including solar panels, inverters, charge controllers and resource estimation. Activity: Assemble a photovoltaic system.

Temple University – Of the Commonwealth System of Higher Education

Philadelphia, PA

Temple University's Electric Energy Group, led by Assistant Professor Liang Du, seeks to leverage our existing education resources in electric power systems, expand available platforms from our ongoing senior design projects (sponsored by the State of Pennsylvania and local utilities), and build a smart home platform to educate middle and high school students and teachers (both in-person and on-line) on cutting-edge smart grid concepts and technologies. Through a series of educational programs, detailed below, we propose to utilize our existing teaching resources such as solar panels, smart UPS, data acquisition, load management, big data, GPU workstation, and digital controls so that participating students will be exposed to all aspects of end-user energy management and fully understand opportunities and challenges in the future Internet of Energy. The target smart home platform will consist of state-of-the-art energy consumption management software, smart outlets, voice-controlled switches, various (both traditional and smart) loads, and a cloud-computing driven "Grid Operator." Data analytical tools will visualize and demonstrate home energy data to help students understand fundamental concepts such as prosumers, microgrids, power quality, demand

response, and smart grid. Students will experience smart home energy management through voice interfaces and intelligent controls and learn how end-user participation could impact our nation's energy infrastructure paradigm shift to a more sustainable, reliable, and resilient power grid. The program will also collaborate with local utility companies as appropriate to incorporate industry needs and expectations into educational programs. Dr. Du has developed strong relationships with engineers at PECO and Exelon who work on transportation electrification, investigations of high-phase order transmission lines, and distribution voltage analysis. To guarantee the success of the proposed education program, we propose to integrate the E2 Energy to Educate program with ongoing K-12 STEM education programs, such as Pennsylvania Mathematics, Engineering, Science Achievement (MESA) as well as Women's Engineering Explorations (WE2).

The Research Foundation for SUNY at Oswego

Oswego, NY

When energy depletion and environmental pollution are of concern, an obsolete energy concept -- pedal power comes alive due to its clean and renewable nature. The proposed project seeks to investigate the old energy concept and give it new life by employing modern energy generation and conversion technologies. Considering the most-often seen pedal power today is generated in gyms during exercise, the Smart Gym concept is explored in this project which collects the pedal power produced by humans and generates electricity to power loads, or charge batteries, or feed the utility grid. Thus, the Smart Gym is more efficient, clean, and cost-effective, and importantly, can be part of the Smart Home concept. It can also be an economic solution for electricity where or when electricity is not available, like remote or rural areas, camping sites, and emergency conditions. In this project, under the guidance of faculty, SUNY Oswego undergraduate students will investigate the feasibility of the Smart Gym concept, design, develop, and demonstrate stand-alone and grid-connected Smart Gym systems. The project includes 5 steps and will be completed in 2.5 years. By participating in the project, students will be able to gain a deep understanding of energy generation and conversion technologies, enhance their engineering skills, and be inspired to pursue a career in energy industries. The outreach component of the project will educate K-12 students on energy generation and conversion and expose them to state-of-the-art technologies so as to motivate more children to pursue STEM education. Overall, the project will directly engage at least 10 undergraduate researchers and be accessible to more than 150 undergraduate students in the Electrical and Computer Engineering program at SUNY Oswego through seminars, presentations, and other campus activities. It will also impact ~360 young students in local K-12 schools via the project's integrated outreach activities. In addition, the project will make the community aware of a new clean and cost-efficient energy choice by introducing the Smart Gym concept. To generate power may become a new reason to engage in exercise, which encourages people to exercise and stay fit and healthy. It may not only modify our pattern of energy generation and use, but also positively influence our lifestyle.

The Research Foundation for The State University of New York

Oswego, NY

The ultimate goal of the proposed effort is to develop the technology for high-performance and safe rechargeable sodium ion batteries based on environmentally benign ferrite nanomaterial electrodes for electric vehicles and grid-scale technology as an alternative to the current lithium ion batteries. Rechargeable lithium ion batteries (LIBs) have progressed tremendously over the last few years. Despite the obvious advantages, however, the application of LIBs to grid-scale energy technology is hampered by several factors including the high cost related to the need for carefully purified materials, electrode degradation, relatively slow cycling rates, and safety issues. This project seeks a shift of paradigm in rechargeable battery technology through a combination of Density Functional Theory (DFT)-driven design and chemical synthesis of environmentally benign compound ferrite nanomaterials. These will lead to the fabrication of sodium (Na) ion batteries (NIBs) based on ferrite nanomaterial anodes that involve a conversion mechanism rather than intercalation. The nanomaterial systems will be investigated with electrochemical characterization of the fabricated NIBs, analysis of cycled NIB anodes through Electrochemical Impedance Spectroscopy (EIS), Raman spectroscopy, and X-ray Diffraction (XRD).

Trustees of Boston College

Chestnut Hill, MA

Funds will enable us to expand a smart-automated mini-greenhouse (12"x16"x20") project in which middle-school youth design, code, and evaluate an automated greenhouse. We have chosen to focus on infusing automation through the use of a mini-greenhouse because by studying how environmental conditions impact plants teachers are able to meet multiple national and state standards. This is important because most schools that serve low-income youth are under pressure to get through certain science concepts to prepare their students for standardized testing which means that the teaching of skills and knowledge around automation is highly unlikely to occur unless it is embedded in curriculum materials that meet the standards and content that teachers need address. Further, at the current time most middle school science teachers have very little experience with coding and automation and are far more comfortable with teaching about plants and ecosystems rather than automation and coding. We have developed a suite of tools using a low-cost microcontroller, low-cost sensors and through the use micro-python to enable youth to program and automate their greenhouse quickly and easily while learning the importance and value of automating both the data collection and operation of their smart greenhouse. The materials are completely re-useable which will enable school systems to implement the project over and over again in years to come. We anticipate that we will impact 600-800 student across the project locations.

University of the Sciences

Philadelphia, PA

This project will enable a Renewable Energy-themed Summer Physics Camp for Middle School Girls, known as Physics Wonder Girls at University of the Sciences (USciences). Two elite cohorts of 15 rising 8th and 9th graders from diverse backgrounds are selected, from a pool of top-performing students nominated by their science teachers. Mentored by the PI and an undergraduate STEM crew grounded in the fundamentals of renewable energies, the cohort will work in teams as they undergo an intensive week of project-building, experiments and demonstrations focusing on renewable energies: solar energy and fuel cell technologies, including their physical basis, generation, storage, transmission, and application. Novel technologies targeted will include conventional and organic solar cells, luminescent materials, and advances in fuel-cell technologies. Campers will participate in project-building (solar boats and cars, micro-grid solar station, build-your-own-solar cells, a mini-greenhouse using luminescent materials, fuel-cell cars, wind turbines), physics experiments, a camper poster session on renewable energies, physics-based games, industrial and research lab tours, and inspiring STEM career talks by women scientists and engineers from the private sector and academia. The camp will end with a capstone Community Energy Show by the newly-minted Energy Girl Ambassadors who will perform their favorite energy demonstrations to a roomful of family, teachers and friends. Select campers and crew will participate in community energy outreach at the annual Philadelphia Science Carnival, which is visited by over 70,000, where they will lead energy-based demonstrations to excite and stimulate interest in renewable energy. Finally, the energy equipment and materials will be used during the regular semesters to catalyze and energize energy-based undergraduate education and research at USciences.