



SOCIETY OF PHYSICS STUDENTS

An organization of the American Institute of Physics

Future Faces of Physics Award Proposal

| | |
|------------------------|----------------------------------|
| Project Proposal Title | "I can Science" |
| Name of School | The George Washington University |
| SPS Chapter Number | 2319 |
| Total Amount Requested | \$340.63 |

Abstract

"I can Science" is an outreach program put forth by The George Washington University's SPS chapter to promote hands-on physics learning through demonstrations for African American boys ages 6-13 from lower socioeconomic statuses, who are a part of Life Pieces to Master Pieces' after school program.

Proposal Statement

Overview of Proposed Project/Activity/Event

“I can Science” is just one aspect of the multifaceted mission of Life Pieces to Masterpieces (LPMP). The program aims to develop character, self-resilience, and integrity in the young African American men while fostering mentorship relationships with positive role models. Our chapter of SPS has been involved in the program for the past five years and has aspired to invoke passion for physics and general science in the boys. SPS members engage the boys with a variety of physics demonstrations to promote enthusiasm for science in a fun learning environment.

Each year we have volunteered with the program, we prepare six lessons, each including three or four different lab stations. SPS members and the advisor travel to Drew Elementary School on Friday afternoons to prepare the lab stations for students to interact with and learn about different physical phenomena. Last year, during the semester of Spring 2018, each week's lesson was geared towards how we can make different objects move. Some of the lab stations students have previously engaged in are stomp rockets to explain ballistics, object races to teach concepts of moment of inertia, and a van der Graaf generator to teach electrostatics. Each week we visit about ninety boys who are a part of three classrooms, divided by age: ages six to eight, nine to ten, and eleven to thirteen. The concepts that the SPS members teach while demonstrating each station varies depending on the age of boys. For example, the younger students may learn about the general concept of gravity, but older students may learn about the mass and distance dependence of gravity.

Each station is designed for students, so they are to play with and inquire about different physical concepts. SPS members are instructed to teach the physical concepts, rather than the mathematics driving these ideas, in order to make the material as accessible as possible. Students are able to construct their understanding and knowledge of the topic each week using the ideas and concepts they have learned from previous weeks or while in school. In previous years we have also established a ‘portable science station’ where certain items, such as LED light sources and polarization lenses, can be used by the boys even when our SPS chapter is not there. This year, in addition to purchasing supplies for the outreach program and different physics demonstrations, we would want to replenish this portable science station with new materials, including Slinkys and diffraction rainbow glasses. We hope that being able to take home their own science materials, students will feel more connected to the topics they learn and more eager to share their science experience with peers, family, and other mentors.

As we have worked with Life Pieces to Masterpieces in the past, a short-term goal of the project is to reconnect to the students who were in the program last year. Many of our members continually volunteer and the college student to LPMP member relationships are important for the growth and scientific curiosity of the learners. We also hope that by returning, students have a newly invigorated sense of love for science, having hands-on experience with the concepts and allowing for their own curiosity to wander while still learning in a fun, inclusive environment. Our long-term goals for the project include maintaining our strong relationship with LPMP for future years and to invoke long-term passion and love for science in the boys we are teaching.

How Proposed Activity Promotes Physics Across Cultures

Life Pieces to Masterpieces provides a holistic approach to character building by creating support systems, and hosting learning promoting workshops, such as our “I can Science” program. The boys who are a part of this program are usually from Washington D.C.’s more poverty-stricken areas. By engaging these students with physics demonstrations, we hope to invoke a passion for science that inspires students to pursue education or career options in physics, or general science. By making the learning process accessible and fun, we hope to inspire students to take the world of scientific inquiry into their own hands.

Learners from lower economic backgrounds or of minority status can be turned off from pursuing science due to lack of access to resources, and further exacerbated by lack of representation in the field. We hope that by engaging with these students in the “I can Science” project, students are taught that they CAN do science. Helping shape their identity and showing them that they can be, and are, scientific learners, can impact their future attitudes towards scientific discovery. By promoting students from marginalized community with the opportunity to engage in science, we hope to strengthen the diversity in the scientific community.

Our goals can be reached by taking the first step and introducing students to the wonders of STEM and scientific curiosity. The Future Faces of Physics Award would help us achieve our goal and strengthen African-

American youth in acknowledging cultural differences and empowering them to explore and achieve inquiry, now and in the future. By increasing diversity in science, we gain new perspectives on issues due to a wider range of background and outlooks and each individual bringing their ideas and experiences to the table. Learners such as the students in LPMP are the future of our scientific communities.

In the past, students have been very receptive to our program. As soon as we walk into the classroom, we are swarmed by students, telling us about their weeks and where they saw implications of our previous lesson. They are eager to learn! Students are almost always engaged with the demonstration at each station and typically ask questions to build on concepts they have learned in school or from previous weeks in the program. Last year, some students even asked about ways to get more involved with science outside of school. Often times, students will be less eager to learn science in typical classroom settings, because they feel pressure to perform well rather than inquire. Our hands-on demonstrations and engaging SPS members create an atmosphere where not knowing the answer right away is an opportunity to learn and asking questions is a vital step in discovery. When we go to Drew Elementary each week, students' eyes light up with scientific wonder in a way that cannot be measured.

Our outreach experience with the organization has not only benefited the students we serve, but also our SPS chapter members who engage with the students. Members have to manage getting asked many questions relating to the material and learn the best strategies to use when teaching and demonstrating a topic. Students also improve their own learning by thinking of new ways to explain and conceptualize the demonstration and make the material tangible for different aged learners. The outreach program makes it possible for SPS students to get involved in the wider D.C. community and promote their love of science to young learners.

Plan for Carrying Out Proposed Project/Activity/Event

- Personnel – SPS members from the George Washington University will lead each of the stations for the lessons. Students are put into pairs and are assigned a lab station to explain to students and help guide the exploration of the demonstration. SPS members who are new to the process or have less education experience will be paired with more experienced members. As Outreach Chair for our chapter, Jason Starita has taken the lead on the drafting lessons and organizing project logistics and will keep progress reports of the classes we go into. Some activities Jason has proposed so far is a lesson on light that will use laser pointers and the double slit apparatus to show its wave nature. Another lesson introduces the boys to fluids and their properties using oobleck and density gradients. Jason has also discussed working with Ian Dragulet who has applied to SPS Chapter Research Award to work with the boys to learn about how objects land when they are dropped.
- Marketing - The head of LPMP has ensured that we are welcome to come back and perform activities with the boys, as we have been for five years.
- SPS member participation – We currently have sixteen members in our chapter. They are encouraged to come each week and help explain the physical concepts. We typically have five to ten volunteers from our SPS chapter each week. Our current Vice President, Rohan Patil, served as outreach chair last year and will help plan logistics this year, such as transportation and group pairings.
- Expertise – Each of the three to four stations has two SPS members. All the members in our chapter currently are physics, biophysics, or astrophysics majors and have relevant coursework in the topics. Three days before each lesson, students are briefed on various talking points and given strategies to make the information accessible. Students are encouraged to meet with their partner and discuss ways to ensure students will have fun and learn the concepts. Our SPS chapter advisor, Gary White, as well as one of the department's astrophysicists Alexander van der Horst, also attend most weeks.

Project/Activity/Event Timeline

The outreach chair, Jason Starita, has been using the Fall 2018 semester to draft lesson plans and demonstrations for this coming year's topic, 'Where can we Find Physics?'. The "I can Science" program will take place throughout the duration of the Spring 2019 semester. The lesson plans are to be finalized by mid-January and afterwards, an exact schedule will be made of which lab stations will be demonstrated on each day, what materials will be needed, and volunteer pairings. The program will begin in mid-February as we travel to Drew Elementary on Fridays throughout March and April to work with LPMP weekly. After six lessons, each covering a broad span of physical topics, we will conclude the outreach program by mid-April.

Activity Evaluation Plan

Before the program begins, we first talk with all the mentors and leaders of LPMP to obtain guidance on what improvements can be made to last year. Because we want to keep science as fun and as accessible as possible for all learners, there are no formal tests or assessments as part of our program. Instead, in order to evaluate the success of our program, we begin each session by having students sit in a circle and ask them what they learned last week. Students often will discuss topics they enjoyed and create a dialogue between peers and SPS members. At the end of the outreach program, we talk to many of students asking them which activities were their favorites, which ones they did not like, and what they would like to see or learn next year. Hearing from the students is the most important feedback we receive because we hope to make all our lessons as enjoyable as possible for them. We will also talk with the leaders at the end of each week to assess how the outreach program is going and how we can improve for the next week.

Budget Justification

This year's outreach lessons will use some of the old demonstration materials, like a van der Graaf generator and model rockets, in conjunction with new demonstrations to reinvigorate the program.

The prisms will demonstrate how light can travel at different wavelengths and how white light diffracts to form other colors. The pendulum stand will help teach students about oscillators, and specifically how energy is transferred in the form of a coupled oscillator. The free fall vacuum will be used to teach students about gravity, how everything should fall with the same acceleration, and help teach the concept of air resistance. The wind tunnel will be used in various lessons, including the physics of planes and lift and Bernoulli's Principle, in conjunction with the use of a hose. The happy and sad balls will be used to teach students about momentum, and how conservation laws hold and the idea of impulse. The ice melting set will teach students about phase changes and how different materials are better at insulating than others. The astro blaster will help students visualize velocity amplification in vertical collisions. The bicycle gyroscope wheel will be used to teach about conservation of angular momentum. Finally, the mini slinkys and diffraction glasses will be given out on the last day of the outreach program in a portable science station, so students can take home some of concepts they have learned over the past several weeks.

This equipment will benefit the members of LPMP because by using a wider range of demonstrations, students a part of the "I can Science" program will be exposed to a myriad of physical phenomena, many of which we have not used in the past, in hopes of invoking passion for physics and all fields of science.