SOCIETY OF PHYSICS STUDENTS
An organization of the American Institute of Physics

Marsh White Award Report

Project Proposal Title	Quantum Kids: You Got This!
Name of School	University of Maryland
SPS Chapter Number	4155
Project Lead (name then email address)	Tyler McDonnell tybmcd@terpmail.umd.edu
Total Amount Received from SPS	$500.00
Total Amount Expended from SPS	$500.00

Summary of Award Activities

Early exposure to STEM topics helps students identify misconceptions that may take shape at a young age, which can provide them with the foundation to navigate more complex concepts later in their academic careers. Often physics is not covered in K-12 curriculum; moreover, there is not a large focus on quantum physics due to the complexity of the of the subject. To address this issue, outreach activities are frequently designed by higher institutions and are implemented to incite thought and interest on concepts. The University of Maryland SPS received the Marsh W. White Award from SPS National to design a program of activities focusing on several quantum concepts for elementary school students that introduces them to the world of quantum through diverse learning experiences.

Statement of Activity

Overview of Award Activity

The program was two 2-hour sessions focused at elementary school students and their families. The program incorporated the quantum concepts: wave-particle duality, quantization of energy, energy levels, and interacting particles. Each of these concepts were made into stations and were designed to engage the student's interest and evoke thought. Likewise, a quantum library, that held books covering these concepts and more, was made available for students and their parents throughout the sessions.

The sessions started with an opening talk discussing the scope of the program, everyday quantum technologies, current national focus on quantum education, and current research that is being conducted. Afterwards, students were given a passport, which contained questions and fill-in the blank responses, to accompany them through the program to track their progress. With each passport, the students were assigned one of four stations. Station rotation followed. The stations included:

Double Slit Experiment
This station that focused on wave-particle duality had students observed laser light through a double slit, single slit, and circular aperture. Afterwards, they were shown the double slit effect with particles creating the same pattern. Then, they were tasked with creating their own circular aperture to get a closer look at the pattern; they were given polarizers to investigate the effect of the quantum Venn diagram.

Blackbody Radiation
The quantization of energy station looked at blackbodies, how energy is considered quantized, and their discovery through Max Planck. Students built their own black bodies from shoe boxes and colored paper.

LED Well
To understand the concept of energy levels, students participated in a brief discussion on the different colors of the light spectrum and given colored LEDs. Students were asked to see which LED color allowed them to write their name the fastest. Afterwards, they were taught how a forward bias p-n junction operates and how the amount of energy released in light is dependent on the energy gap. Students were then taught that a reversed LED is the basis for a solar cell.

Superconducting track
Students were shown a superconducting track demo and taught how the magnet was able to float across the entire track. They able experience a new behavior of particle interactions visually.

Quantum Library
The quantum library station was available during the activities section of the program for students that wish to either learn more than what the program offered or to give them the option of learning the material in their own way. Parents commented that they generally enjoyed the quantum library as they waited for their children to complete the program. The books provided them with quantum concepts to understand the activities and have discussions with their children.

The project accomplished exposing students to quantum physical concepts, while also highlighting the technologies used in everyday life that make use of quantum physics. Likewise, students became more intrigued with the topic after getting hands on experience with some of these technologies. Upon

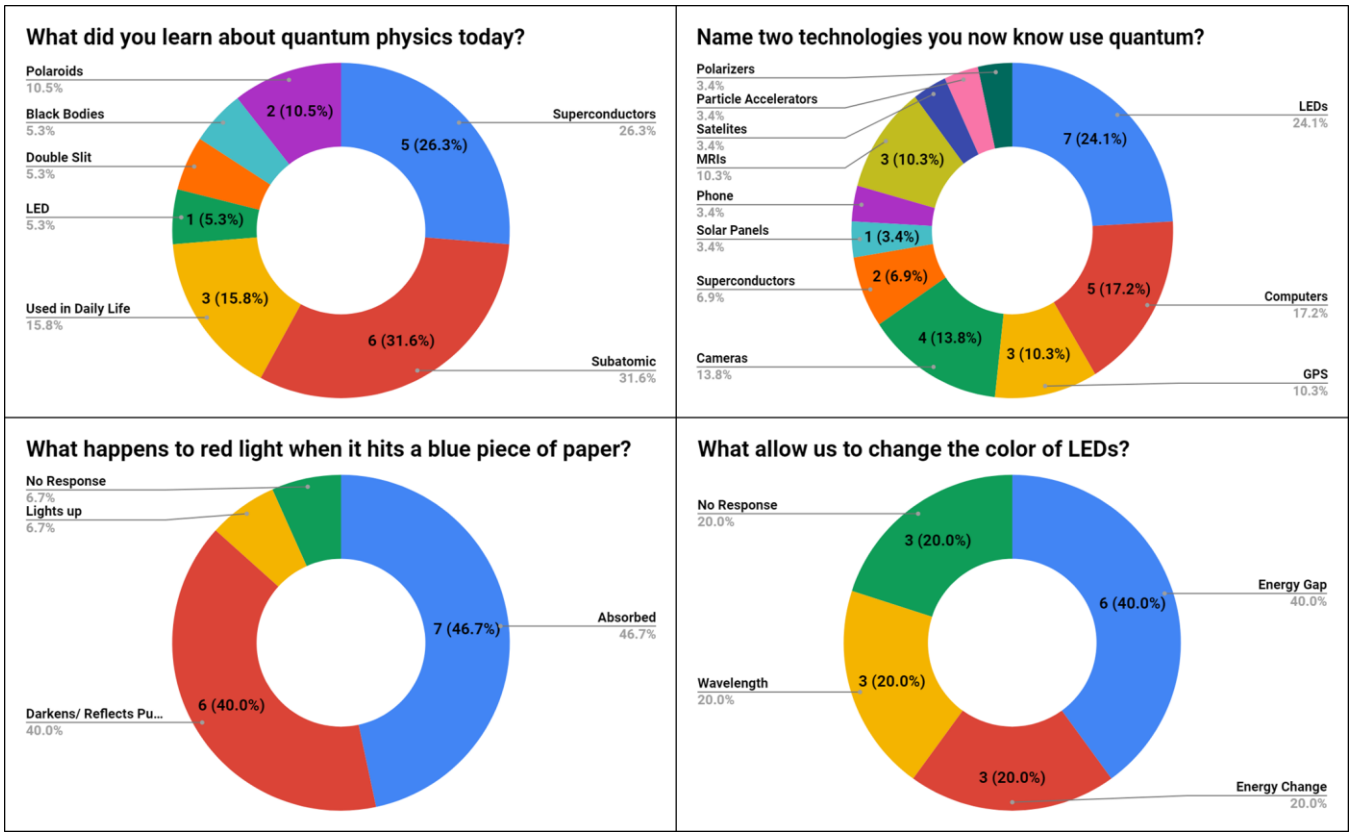
review of the passports, students shown that they could answer the theory questions and fill in the blanks of the science being described.

Impact Assement: How the Project/Activity/Event Promoted Interest in Physics

To promote interest in physics among students and the general public, this project was designed to provide attendees a blend of hands-on experiences and mini demonstrations and lectures. Students enjoyed being able to immediately apply what they had learned. Furthermore, knowledge of everyday quantum technologies was made known to the students throughout the program. Discussions of quantum technologies were included to excite students about quantum physics in their everyday lives. This knowledge surprised some students because they had never thought about the science behind the technologies.

To assess the students' knowledge of the subject, they were given a pre- and post-survey and a passport, which contained questions about the concepts being covered and fill-in the blank problems. Using these instruments, we gather previous knowledge of the student, knowledge gained, and gauge student involvement. The information gathered from the passports showed that most students were actively engaged with only a few unable to complete every question. After student completion of the post surveys, we received positive results. Survey responses showed that students were able to identity quantum concepts covered in the program, identity a connection between quantum physics and their daily lives, understand the information that they were being exposed to, and that they were actively engaged.

Survey results are shown below:



Key Metrics and Reflection

Who was the target audience of your project?	**K-12 communityand Parents; Primary: Grades 4-6**
How many attendees/participants were directly impacted by your project? Please describe them (for example “50 third grade students” or “25 families”).	**The program entirely reached 55 (35 students, 20 adults)**
How many students from your SPS chapter were involved in the activity, and in what capacity?	**There were 8 students leading activities; 3 developed the program**
Was the amount of money you received from SPS sufficient to carry out the activities outlined in your proposal? Could you have used additional funding? If yes, how much would you have liked and how would the additional funding have augmented your activity?	**We are waiting on the remaining funds to cover cost for matertials. The amount of funds will be suffient with our department support.**
Do you anticipate repeating this project/activity/event in the future, or having a follow-up project/activity/event? If yes, please describe.	**Yes, we intend to continue refining the program and plan to intergrate in the Univeristy of Maryland Department of Physics Summer Camp Programs this summer.**
What new relationships did you build through this project?	**We met families and teachers interested in conitinuing working with SPS outreach.**
If you were to do your project again, what would you do differently?	**Since we are planning to refine an implement the project again this summer, we will make it compatible with a summer camp format**

Press Coverage (if applicable)

N/A

Expenditures

The Physics Department generously allowed us to use demos, liquid nitrogen, and perishable supplies to develop our station. We rounded the numbers below.

Expenditure Table

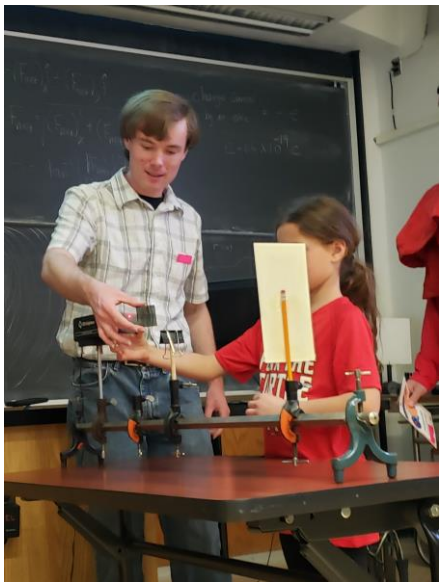
Item	Please explain how this expense relates to your project as outlined in your proposal.	Cost
Books	Quantum Library Station	82.00
Boxes, small white boards, markers, paper	Black Box Station	65.00
Demo Laser	Laser (partial support)	200.00
LEDs	Energy Level Station	26.00
Wall	Energy Level Station	105.00
Index Cards, Crayon, Tin Foil, Colored Pencils	Double Slit Station	30.00
	Total of Expenses	508.00

Activity Photos

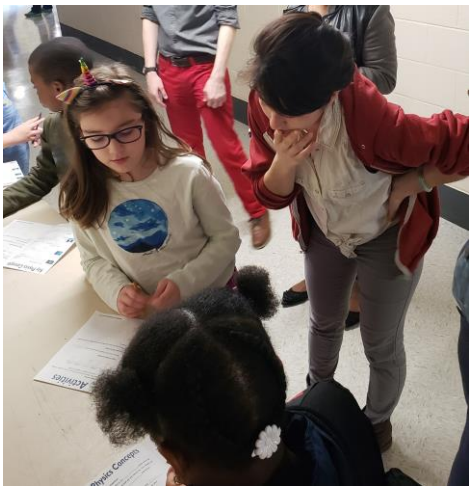
Photo of Quantum Kid: You Got This! team. Left to right: Donna Hammer, Robert Whitlock, Cody Kuntz, Thomas Gleason, Peter Mielke, David Stewart, Tyler McDonnell.
Photo Credit: Cody Kuntz

Students create their own blackbodies, while being taught about their significance by Thomas Gleason.
Photo Credit: Cody Kuntz

Post-Doc David Stewart explaining Superconductors to a student.
Photo Credit: Cody Kuntz



Peter Mielke assisting a student in showing the effects of inserting two differently oriented polarizing filters in line with the laser light.
Photo Credit: Cody Kuntz



Anaïs Roche attempts to provoke thought amongst the students while assisting them with the passport.
Photo Credit: Cody Kuntz

Student being questioned by Robert Whitlock on the effects of shining light through a polarizing filter.
Photo Credit: Cody Kuntz

If you have any questions, please contact the SPS National Office Staff
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