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

Marsh White Award Report

Project Proposal Title	The "Phun"-damentals of Physics
Name of School	The George Washington University
SPS Chapter Number	2319
Project Lead (name then email address)	Sri Murthy sri@gwu.edu
Additional Project Leads (two lists: names then emails)	Jacob Maibach, Brian Alden jmaibach@gwu.edu, brianalden@gwu.edu
SPS Chapter Advisor	Gary White
Total Amount Received from SPS	$486.25
Total Amount Expended from SPS	$381.41

Summary of Award Activities

The George Washington University SPS chapter conducted weekly physics workshops for elementary and middle school students at the DC afterschool program Life Pieces to Masterpieces. For six weeks, we engaged students with activities such as making oobleck and experimenting with plasma balls. Each activity served as a demonstration in a lesson on the physics of everyday things. For instance, the plasma balls were in a lesson on lightning and electricity. We ended the year by presenting the program with a 'mobile science station' so the students could explore physics on their own.

Statement of Activity

Overview of Award Activity

Life Pieces to Masterpieces (LPTM) is an afterschool program for African American boys in Washington, DC. In the past few years, it launched the I CAN (innate creative ability network) project, in which their students engage in special workshops every Friday for six weeks. These six week sequences run in the Fall and Spring. For the past two years, we have hosted one of the sequences in the Spring.

Multiple workshop sequences run simultaneously and the students decide which to attend, if any. For instance, the staff at LPTM run 'I CAN Cooking', and our sequence is 'I CAN Science'. The first week consists of a pitch session, in which the students are given a 15-minute preview workshop to help them decide which sequence to participate in. The next five weeks consists of pairs of 45-minute workshops, one for a younger group and a second for an older group.

This year, we had 30 total students, 16 in the younger group and 14 in the older, up from 10 students total last year. To accomodate the larger number of students, we designed each workshop to be station-based; typically, there were four stations, each run by one or two undergraduates. Each station included a few small demonstrations related to the theme of the workshop (e.g. electricity and lightning). Typically, we had group-wide activities at the beginning and/or end of the workshop to introduce or conclude the workshop.

We started with three sessions on magnets and electricity. In the pitch session, we introduced the idea that magnets create invisible fields, which the students used to design and image patterns with iron fillings and light-sensitive 'sunprints'. The second session extended on magnetism with various electromagnetic demonstrations, such as a simple induction-based light. The third session discussed electricity and lightning, using plasma balls as proxies for lightning. The students explored related topics such as statics with balloons and electric audio with a small speaker.

The next three sessions were two on optics, and one final session on sound and matter. After having talked about lightning and thunder storms, we discussed rainbows. We used rainbows and colors as the theme for the next session, where we gave them 'rainbow' glasses so they could explore the spectra of various light sources. In this and the next (on light and the sun), we introduced them to polarization with 'stained-glass windows' involving polarizing film and tape. We explained the concept with an interactive group-activity involving slinkies and meter stick gates. Our last session was an amalgam inspired by the students favorites from this year and last. We did various demonstrations with speakers and oobleck, which the students got to make afterwards. We finished with liquid nitrogen ice cream as a treat to everyone involved, students and presenters.

At the end of the last session, we presented the program with a 'mobile science station' containing things from and related to the workshops we held. The items fall into three categories. First, it contains items such as prisms which the students can use to further explore the topics we discussed. Second, it contains award-winning children's science books such as *Batman Science: The Real-World Science Behind Batman's Gear*. Third, it contains one tangentally related item - a laser and mirror variant of chess (the kids there are avid chess players).

This outreach furthermore serves as a point of engagement for new SPS members and for interested faculty. This year, two undergraduates have joined SPS as a result of participating in this project. Two faculty in addition to our advisor have participated in the project.

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

The primary goal of the project was to get students engaged in and excited about physics (and more generally, science) relevant to their everyday life. The students were consistently engaged with the workshops, and staff at Life Pieces told us on numereous occasions how much the students looked forward to our visits. The wealth of student interest is also reflected in our threefold increase of students from the first to second years (10 to 30 students).

Although the informal measures are quite reassuring, we were not so sucessful at collecting more formal measures. Last year, we surveyed the students at the end to gauge their enjoyment of the six lessons. We intended to repeat this, but failed to. We developed another assessment tool to get feedback from the undergraduates, but due to poor timing, we did not get much feedback. However, it will be very useful next year.

The assessment tool incorporates three components. The first is a detailed lesson plan, and the second is a record of the actual events of the session. These should help to determine what types of demonstrations are most and least feasible to attempt. The third component involves judgement as to which demonstrations were most and least effective (what went well and what did not), with additional space for miscellaneous comments. In the future, we plan to develop a survey for the undergraduates to make the process of getting this feedback easier.

Key Metrics and Reflection

Who was the target audience of your project?	Elementary and middle school boys at the Life Pieces to Masterpieces program
How many attendees/participants were directly impacted by your project?	30 students ages 7-14
How many students from your SPS chapter were involved in the activity, and in what capacity?	8 students participated in running the workshops, of which 2 planned the lessons
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?	The recieved funding was more than sufficient. However, if we were to spend more, we would purchase more permanent equipment, rather than relying on borrowing from various individuals.
Do you anticipate repeating this project/activity/event in the future, or having a follow-up project/activity/event? If yes, please describe.	We plan to repeat this project every Spring, and possibly in the Fall.
What new relationships did you build through this project?	We continued to develop our relationship with Life Pieces, and with their new volunteer coordinator, LucyRose Moller.
If you were to do your project again, what would you do differently?	The primary thing we would change is to develop a more thorough plan for the workshops far in advance. Ideally, the majority of all the planning would be done before the first workshop.

Press Coverage (if applicable)

George Washington University Physics Department - Spring 2016 Newsletter (not yet published)

Expenditures

The SPS funding covered most of the direct expenses for this project. The one exception is that we used liquid nitrogen donated by the GWU physics department for the final workshop. In addition to direct expenses, we borrowed a number of items from various individuals (and from the department) to use in the lessons. These items included but were not restricted to: a Van der Graaf generator, a UV light, a speaker system, and gas-discharge lamps.

Direct expenses listed in the table are organized lesson by lesson. The sun-art paper was used in the pitch session on imaging magnetic fields. The batteries, and foil were use for a lesson on electricity and magnetism. The plasma balls were used for a lesson on electricity and lightning. The radiometer, tonic water, polarizer film, and rainbow glasses were used for two optics lessons, and the glasses were given to the students. The plastic wrap and bags were used for a lesson on sound and matter. The ice cream supplies and liquid nitrogen were used (unsurprisingly) to make liquid nitrogen ice cream in the last lesson. Finally, the remaining items are now part of the permanent 'mobile science station' at LPTM.

Expenditure Table

Item	Cost
Sun-Art Paper 8''x10''	8.86
AAA Batteries	9.99
Aluminium Foil*	5.00
Plasma Balls (x4)	68.00
Radiometer	13.30
Tonic Water (x2)*	10.00
Polarizer Film	90.00
Rainbow Glasses (x30)	7.50
Plastic Wrap*	4.00
Small Plastic Bags*	3.00
Assorted Ice Cream Supplies*	20.00
Liquid Nitrogen (donated)	0.00
Science Books (x6)	91.84

The Laser Game: Khet 2.0	27.53
Tedco Light Prisms (x2)	13.58
Rainbow Glasses (x10)	2.50
Sun-Art Paper 4’’x6’’	6.31
Total of Expenses	381.41

*estimated

Activity Photos

All photography credit goes to Life Pieces to Masterpieces.

Making sunprints of magnetic field lines.

Making sunprints of magnetic field lines.

Newton’s Nightmare and electromagnets.

Exploring light spectra with ‘rainbow’ diffraction glasses.