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

Marsh White Award Report

Project Proposal Title	How can Magic be Physics?
Name of School	University of the Sciences
SPS Chapter Number	5619
Project Lead (name then email address)	Kacy Catalano (kcatalano@mail.usciences.edu)
Total Amount Received from SPS	249.50
Total Amount Expended from SPS	249.50

Summary of Award Activities

The University of the Sciences chapter of SPS hosted a booth at the Philadelphia Science Carnival showing the connection between magic and physics. A plethora of tricks were presented to carnival attendees, mostly families with children between the ages of five and ten, by 'a magician', then the tricks were foiled by a nearby 'scientist'. Children were then given the chance to attempt some tricks with the guidance of a physics students. During the course of the day hundreds of children were exposed to the amazing world of physics through the wonders of magic.

Statement of Activity

.

Overview of Award Activity

Our award activity was holding a booth at the Philadelphia Science Carnival. The Philadelphia Science Carnival took place at Penn's Landing from ten to six Saturday April 30. Our booth consisted of two tables covered by a canopy directly across from the water front. Hanging from the canopy was a large sign advertising our title in a slightly altered version: Is there Science in Magic? The tables consisted of different demonstrations arranged in a row so that families could walk in a line and see everything that was available. Behind each table stood three to four students dressed in lab coats and one to two students acting as magicians. The 'magicians' and 'scientists' worked in tandem to grasp the attention of the carnival attendees walking by and then explain the science behind the demonstrations used to attract them.

Seven students were present to be scientists and magicians. The students took shifts during the six hours rotating in an out with at least three scientists and one magician at a time. Our advisor was present during the entire event actively photographing the activities. The faculty from the University of the Science was also a great help with transportation and setting up. At least two faculty members were present at all times to aid in the activities. The activities were separated between the two tables with specific s focus for each table.

The left side of the booth contained the larger optical illusions: levitating water, infinity mirror, Einstein's mask and Bernoulli' principle. Starting at the left end of the booth was the levitating water demonstration. This consisted of a single device that appeared to make water droplets levitate and float upwards. The magician would take control of the water making it bend to his command, then a scientist would explain how the strobe effect causes the water to appear to move up or hover. Children were then allowed to experiment with the stream of water as the water droplets appeared to float upward.

Next was the infinity mirror and Einstein's mask which were strongly visually attracting. Audience members were encouraged to find the end of the line of stars in the infinity mirror which the magician would explain as a universe caught in a piece of magic glass. Similarly with Einstein's mask, audience members were encouraged to move back and forth and watch the face pop out and follow their path. This the magician would say was Einstein actually caught in a piece of stone by a spell. After the magician finished his bit the scientists would say how silly the magician sounded and ask the kids what else they could use to explain the illusion. The kids would cheer out "Science!" and then the scientists would proceed with the explanation.

One demonstration that really highlighted the beauty of the activity was 'magic levitation' which shows Bernoulli's principle. We had the magician fail at doing the demonstration by holding the hair dryer askew underneath of the foam ball, then have one of the kids hold the magic wand and successfully balance the ball in the air channel created by the hair dryer. This always put a smile on the face of the child holding the wand and the rest of the crowd would cheer enthusiastically.

The right side of the booth focused on activities the audience could do at home: exploding fizz, shrinking coins, steel straw, balloon skewers, floating lemons and disappearing coin. Scientists and magicians would guide

the audience members by demonstrating the different activities and then hand out supplies for the audience to try. While the audience members took their turn the scientist would explain what was happening.

Erupting fizz was done in a single beaker on the table. This was done repeatedly each time that the members of the audience replenished. It was important to poor the soda slowly to prevent the carbon dioxide from being released. Audience members could add the other ingredients without impacting the demonstration negatively and were encouraged to do so.

Paper, coins, balloons and skewers were distributed to members of the audience so they could attempt to do the shrinking coin and balloon skewer demonstrations before they were explained. The magician would do the demonstration without giving away his or her secret to give an idea of what to do. After a few laughs over failed attempts or cheers over successes the scientists would explain how the different demonstrations worked.

This activity helped spread physics to hundreds of families by taking advantage of the allure that magic offers. Different illusions offered insight into optics and how the brain reacts to light. Simple parlor tricks, like the balloon skewers, gave the audience something memorable that they can take away and remember.

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

The goal of our outreach was to use magic to capture people's natural curiosity and then enrich their brains with the underlying physics. It was also our intention to make physics applicable to everyday life so that the science will go home with the audience. We used surveys to assess how well we meant our goal. The surveys were composed of two questions on a rating scale, one to ten, and three open ended questions. Both rating questions assessed how well we meant our goal: the first asked to 'rate how interesting the demonstrations were' and the second asked 'how well was the science explained. The open ended questions were for improving future outreach attempts using the same equipment and asked about favorite demonstrations and ways to improve.

Forty surveys were filled out during the day and then analyzed. The average interest rate was a 9.75 out of 10, and the explanation rate was slightly behind at 9.19 out of 10. We are extremely happy with these ratings and believe they reflect our outreach event well. The open ended questions also went spectacularly. One questioned asked for the audience's least favorite demonstration or part of the booth and more than half of the surveys said nothing was bad and not to change. Especially exciting was the ten percent of the surveys that asked for more demonstrations and more science festivals. The only negative comments were about overcrowding because too many people were interested. Some of our favorite responses were:

- "My favorite part was the water flowing up, I always wondered how they do that and now I know!"
- "You can't improve your demonstrations, they are already the best!!"
- "They had several experiments that were different and they explained using things that younger kids can relate to"
- "My favorite parts it that I learned something new"

During the carnival the families were very interactive with the magician and scientists. Many of the children were encouraged by the children to interact and take part in the demonstrations. After each of the demonstrations the crowd would burst into applause causing more people to be attracted over. The masses were very thankful and many the audience members took the time to personally thank the scientists and magicians.

Future attempts at using these demonstrations can be improved by offering more space for interactions. The audience was packed very tightly at the tables and many had trouble seeing. Also erupting fizz needs to be

done on a large scale in a small environment to reach its full potential, an outdoor environment at 500mL did not do the demonstration justice. Most importantly many more balloons should have been bought then thought necessary, they popped very frequently.

Key Metrics and Reflection

Who was the target audience of your project?	Children K-12
How many attendees/participants were directly impacted by your project? Please describe them (for example "50 third grade students" or "25 families").	Hundreds of families stopped to see our demonstrations including adults, teenagers and young children.
How many students from your SPS chapter were involved in the activity, and in what capacity?	8: seven at the carnival One involved solely in planning
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 amount of money received was sufficent for carrying out the proposed activites.
Do you anticipate repeating this project/activity/event in the future, or having a follow-up project/activity/event? If yes, please describe.	We intend on doing a similar event at a Philadelphia high school in the Fall 2016 semester.
What new relationships did you build through this project?	N/A
If you were to do your project again, what would you do differently?	Increase the amount number of balloons purchased. We ran out of balloons about a third of the way through the carnival.

Press Coverage (if applicable)

During the carnival a reporter from the Philadelphia Inquirer talked to one of our students, Luke Conover, about our booth. She said that she would submit a story including our booth, but her boss makes the final decision. There has not been any story published about our booth at this point in time.

Expenditures

When corresponding with the event coordinator from the Carnival we discovered that some of the activities planned would not work well with the layout of the carnival booths. We adjusted our purchases according to the arrangement of the booth, such as not buying towels for cleanup and not doing the 'pull the table cloth' trick. To compensate we invested the funds into other tricks that can be used to show the physics in magic.

Certain cost, that would take us beyond the money granted, were absorbed by the University of the Sciences math, physics and statistics department. The largest of these cost was the booth at the science festival. Also a few materials were supplied from the department, as well. The most important material supplied by the department were two extension cords used for the levitating water demo, hairdryer, garage blower, and light (also supplied by the department). The students used their own lab coats and are expected to do the same in the future.

Expenditure Table

Item	Please explain how this expense relates to your project as outlined in your proposal.	Cost
Apples	Used for 'steel straw'	5
Lemons	Used for 'floating lemons'	2
Salt	Used for 'erupting fizz'	2
Oil	Used for 'erupting fizz'	10
Alka seltzer	Used for 'erupting fizz'	8
Soda	Used for 'erupting fizz'	5
Skewers	Used for 'balloon skewers'	2
Bowl	Used for 'floating lemons'	7
Cutlery	Used for 'floating lemons'	2
Straws	Used for 'steel straw'	3
Disappearing coin bank	Used for 'disappearing coin'	8
Balloons	Used for 'balloon skewers'	7
Matches	Used for 'floating lemons'	4
Garage blower	Used for 'magic levitation'	24
Levitating water demo	Used for 'levitating water'	139
Foam balls	Used for 'magic levitation'	4
Infinity mirror	Used for 'infinity-in-a-box'	70
Einstien's mask	Used for 'einstien's mask'	25

Hair dryer	Used for ‘magic levitation’	20
Lenzs law apparatus	Used for ‘lenzs law’	25
Fly stick	Used for ‘fly stick’	30
Boom wackers	Used for ‘boom wackers’	25
Costume	Used for magicians costume	55
Baby pool	Used to contain mess	8
Table cloths	Used to cover tables at booth	9
Total of Expenses		499

Activity Photos

Seen here is a magician, Oberon Wackwitz, and his assistant, Caitlyn McConnel, helping two children pierce balloons with skewers.

A group of students gaze at a stream of water droplets that appears to be floating as a scientist, Kacy Catalano, explains the strobe effect.

A child with the help of a scientist, Katee O'Malley, balance a foam ball in a stream of air from a hairdryer.

Shown here is an overview of the two tents that contain all of the demonstrations made available by the Society of Physics Students.

Scientist Katee O'Malley explains how to put a plastic straw through an apple to a group containing both children and adults.

A group of children are putting coins inside a box that makes the coins vanish, while scientists, Katee O'Malley and Phil White, explain how a mirror is creating the illusion.

Scientist Kacy Catalano explains the science behind the infinity mirror and Einstien's mask shown on the table.

A close up of the two tables containing all of the demonstrations made available by the Society of Physics students.

If you have any questions, please contact the SPS National Office Staff
Tel: (301) 209-3007; Fax: (301) 209-0839; E-mail: sps-programs@aip.org