



# SOCIETY OF PHYSICS STUDENTS

An organization of the American Institute of Physics

## Marsh White Award Report 2016

Project Proposal Title	The Year of Light: Inspiring Kids with the Beauty of Physics
Name of School	Cleveland State University
SPS Chapter Number	1247
Project Lead (name then email address)	Christian Gunder Goonderbog@gmail.com
Additional Project Leads (two lists: names then emails)	Krista Freeman <a href="mailto:k.g.freeman22@gmail.com">k.g.freeman22@gmail.com</a>
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Total Amount Received from SPS	\$500.00
Total Amount Expended from SPS	\$500.00

## Summary of Award Activities

Inspired by our departmental focus on optics and imaging, Cleveland State University's SPS developed a set of monthly interactive lessons for K-7 school students about light. These lessons were carried out through our established physics outreach ("Physics Fridays") with Campus International School, a public school in downtown Cleveland.

### Statement of Activity

#### Overview of Award Activity

Cleveland State University's chapter of SPS continued our established physics outreach program ("Physics Fridays") for the students at Campus International School, a public K-7 school located in downtown Cleveland. Inspired by our department's strong emphasis on optics and imaging, we developed a semester long program to teach students about light. Our hands on lessons walked students through the fundamentals of the physics behind light.

## 2013-2014 Marsh White Award Final Report Template

Our outreach program has been delivered over four days: December 16, February 5, April 29, and May 20. We started with demos and activities that illustrated the wave nature of light and its interaction with different materials. We then taught the students about refraction, diffraction, and interference using monochromatic light. Next, we introduced the concepts of light's wavelengths and energy, effectively allowing the students to discover how color changes the way light interacts with materials. After establishing this foundation, we carried out some new applications-based lessons, starting with conducting some basic experiments with lenses and mirrors and using this knowledge to explore cameras. We also discussed some optics-based technologies, like optical fibers, solar panels, and LED.

We concluded the semester by designing a highly-interactive final lesson ("Physics & Optics Day") in which the students visited the physics department of Cleveland State University, exploring general university teaching labs and specifically teaching and research labs that utilized various forms of light/optics. We hope that using light, which kids interact with and experience every day, will help students to strengthen their already blossoming physics intuition. Each specific lesson was delivered via interactive activities and demos taught within the 1-1.5 hour timeframe that is the Campus International School (CIS) afterschool care program, as well as having them spend the entire morning on campus in our physics department for the Physics & Optics Day. The program—ran by YMCA—is ever growing and caters to students from kindergarten to 7th grade.

This presents a bit of a challenge for us, since the maturity, interest, and intellectual levels of our group are as widely diverse as the students' ages. In recent years, in particular, we have been struggling to make the outreach accessible and exciting to everyone in the wide range of students. Focusing on optics will allow us to meet this goal, since we have already developed optics foundations lessons for the younger students (thanks to previous Marsh White awards) and we can adapt those with more detailed information and new supplies for the older students who have already mastered the basics. Using optics and light, we were highly successful in grabbing the attentions of both Kindergarteners and 7th graders, as well as learning a little something about physics ourselves!

All in all, it was a very rewarding experience to say the least!

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

Our goal was to promote an interest in science (particularly physics) by cultivating inquiry-based discovery and development of science/physics intuition. We had hoped that through this set of lessons, where we will attempt to take the "hands-on" approach to a whole new level, we would bring out the scientific inquirer within all of the students. Moreover, we had hoped to inspire them to look at everyday objects and phenomena under a new "light", seeing the physics behind them. By teaching the students about light, which they interact with and observe countless times each day, we hoped to give them pieces of knowledge that they would think of often and recall in the future.

One great illustration of this effect came the last time we taught students optics. We passed out diffraction glasses for part of the lesson and when the lesson was finished and the students were going home, we overheard one student excitedly telling his dad that white light is actually ALL of the colors of light together. His fascination with that "simple" idea, and the fact that he will likely think of this fact many times when he sees white light, is proof enough that even the simplest of concepts can have a lasting effect on a child's curiosity about the world.

Surveys were given out to students and outreach volunteers to gather opinions of the whole outreach effort. See attached for that particular feedback.

**Key Metrics and Reflection**

Who was the target audience of your project?	Students in grades k-7.
How many attendees/participants were directly impacted by your project? Please describe them (for example “50 third grade students” or “25 families”).	Anywhere between 20-60 kids Grades K-3 each were represented by about 5-10 kids with the rest of kids coming from grades 4-7.
How many students from your SPS chapter were involved in the activity, and in what capacity?	Typically three members of SPS chapter planned/scheduled the activity in advance. Six to eight SPS members and Dr. Streletzky were involved in specific lesson planning, rehearsing, and delivering the outreach.
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 was sufficient for the Spring semester. (: More funding would be cool to ensure sufficient funds for the fall semester C:
Do you anticipate repeating this project/activity/event in the future, or having a follow-up project/activity/event? If yes, please describe.	We would like to do a “Year of Light II” themed outreach beginning this fall. A project-based year-long school day activity for 6th and 7th graders at CIS is being planned too!
What new relationships did you build through this project?	Meeting new kids and inspiring them to be curious. Meeting Ms. Karla Arlens, science teacher for 5 and 6th grade from CIS. She would be instrumental in setting up school-day science project activities with students from 5,6,7 grades.
If you were to do your project again, what would you do differently?	This isn’t a complaint about APS/MWA—more so Cleveland State. It was infinitely frustrating to work with the student life group at CSU (those in charge of our finance account), due to their policies and restrictions with purchasing items, such as our outreach equipment. The process of using the MWA funds from our personal account took too long and, overall, proved to be more difficult and complicated than was expected. We would like to meet with this organization in the near future to discuss possible alternatives to storing our outreach funds. Unfortunately, because of this, we couldn’t get proper supplies until the very end of the semester.

### Press Coverage (if applicable)

N/A

## Expenditures

The SPS outreach team had previously developed some optics demos with the aid of previous Marsh White awards. We also had a collaboration with CSU's Physics Department, which provided a wealth of optics-based equipment. However, we wanted to have some outreach equipment strictly dedicated to optics. Also, we had several new applications-based lessons developed. In particular, we eventually were able to receive supplies to effectively teach about the workings of cameras, solar panels, LEDs and fiber optics. In addition, we wanted to realize a long-standing dream to create an "Optics Olympics" –complete with mirror mazes, which we have struggled with in the past. However, after having difficulty working with those in charge of our finance account, we had to put off this "Optics Olympics" for the fall, replacing the event with two days in which students came to our university to explore the physics department.

### Expenditure Table

Item	Cost
50 Pack, Glow Sticks	\$10.00
Solar panel educational kit	\$20.00
Eisco Lab Complete Optics Bench and Attachment Set	\$167.00
Glow-in-the-dark Stars, Wall Decals	\$15.00
Laser Maze Logic Game	\$108.00
4M Illusion Science Kit	\$20.00
Bigshot Camera	\$100.00
Neon Paper Pack	\$6.00
LED Bracelet	\$54.00
<b>Total of Expenses</b>	<b>\$500.00</b>



## Activity Photos

The following photographs, unless otherwise noted, were taken courtesy of Dr. Kiril Streletzky.



Total internal reflection and Fiber Optics demo



Monochromatic Light Applications



Polarization phenomena



Refraction of light by transparent Material



All for one; one for all: wave nature of light





Physics Day at CSU: Laser light Interference



Physics Day at CSU: Ray Splitting



Physics Day at CSU: Conservation of Momentum



Physics Day at CSU: String Theory lecture



Physics Day at CSU: Diffraction gratings



Optics of electrons, applications: SEM lab in CSU

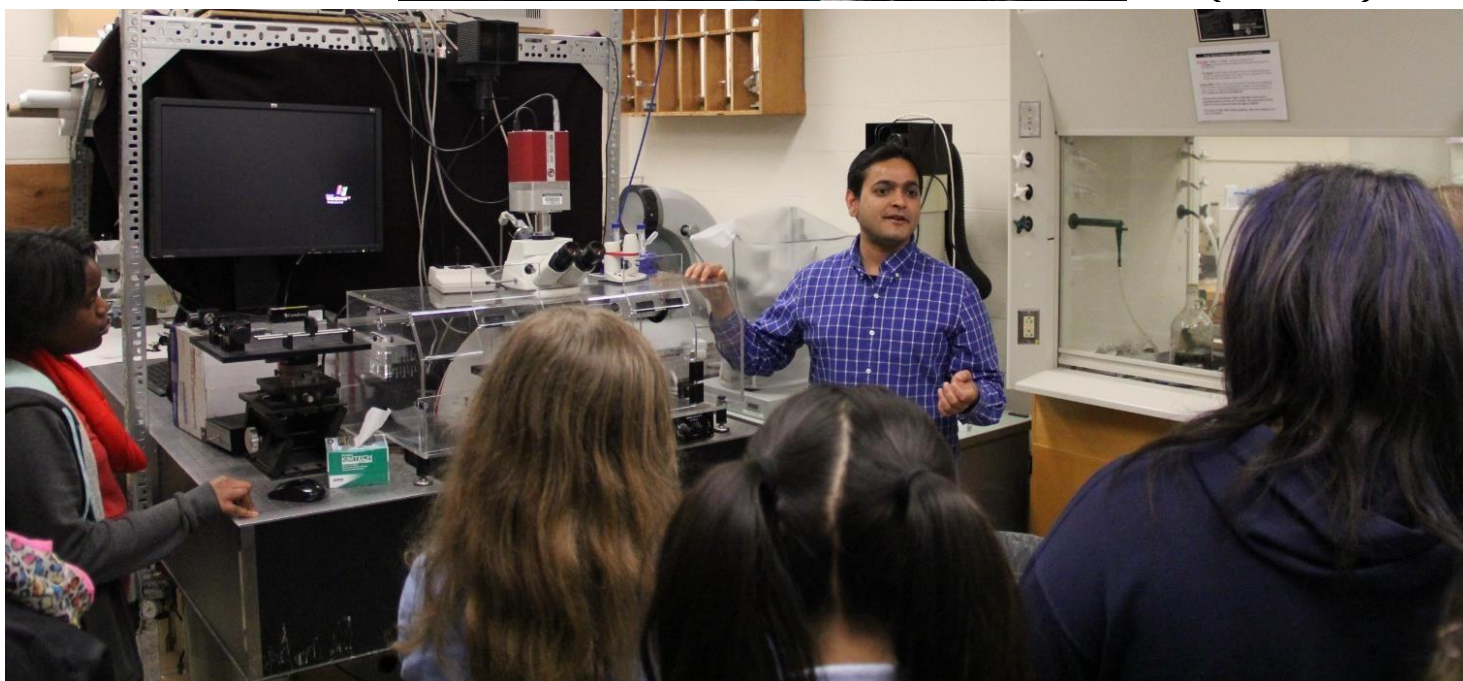




The Scanning  
Tunneling  
Microscope...  
(above, right)



... and the  
Optical  
Tweezers  
Lab!  
(below)







Students; Teachers; Scientists



Supplies purchased using Marsh White funds



# Surveys

## Physics Day 2016 Survey: Teachers

How did we do?

1. How well were your students engaged/ challenged during Physics Day 2016? Check all that apply.

- Very engaged
- Engaged
- Poorly Engaged

2. How well do you think the stations during physics day promoted the idea of pursuing a degree in a STEM field? Check all that apply.

- Very well
- Well
- Poorly

3. How efficient do you feel the Physics Day 2016 timeline and structure was planned? Check all that apply.

- Very efficiently
- Efficiently
- Not efficiently

4. How well did the CSU SPS student volunteers establish a positive, beneficial learning environment for your students? Check all that apply.

- Very Well
- Well
- Poorly

5. How much do you think the initial Physics Day 2016 Demo benefited your students? Check all that apply.

- Very Well
- Well
- Poorly

6. How well do you think the interactive lab tours benefited your students? Check all that apply.

- Very Well
- Well
- Poorly

7. How well do you think the String Theory and Art talk inspired students to think outside of the box, when it comes to science? Check all that apply.

- Very Well
- Well
- Poorly

8. How well do you think that the pizza and liquid nitrogen ice cream social benefited your students? Check all that apply.

- Very Well
- Well
- Poorly

9. How likely are you to want your students to participate in CSU Physics Day in the future? Check all that apply.

- Very likely
- Likely
- Not Likely



# Surveys

## SPS Survey: Outreach Members

How well do we do?

1. How effective do you believe visiting Campus International is for the students?

Check all that apply.

- Very Effective  
 Effective  
 Not Effective

2. How effective do you believe Physics Day 2016 was in promoting careers in the STEM fields for the students? Check all that apply.

- Very Effective  
 Effective  
 Not Effective

3. How would you improve Outreach for next year?

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4. What Fall 2015/ Spring 2016 Outreach event strikes you as the most successful and why?

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5. What do you believe the students take away from CSU SPS Outreach?

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6. What do you take away from participating in the Outreach?