



SOCIETY OF PHYSICS STUDENTS

An organization of the American Institute of Physics

Marsh W. White Award Proposal

Project Proposal Title	From Cold Milk in the Morning to Reading Light at Night: Our Encounters with Physics Through the Day	
Name of School	Cleveland State University	
SPS Chapter Number	1247	
Total Amount Requested	\$300.00	

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Abstract

The Cleveland State University (CSU) physics students will use the award to continue our outreach program with a local public school. This year our program will explore the way school-aged kids encounter physics every day: from refrigeration of milk at breakfast to switching off reading lights at night.



Proposal Statement

Overview

CSU SPS launched its outreach program in January 2011 with the help of the Marsh W. White award. For last 2.5 years our program has been bringing hands-on physics-based learning to Campus International School (CIS), a K-5 public school in the Cleveland Metropolitan School District operated in partnership with the university. Volunteers from our SPS chapter have researched, planned, rehearsed, and delivered interactive physics education disguised as fun activities to students in after school care.

Once a month SPS volunteers lead physics activities with about fifty K-5 students. The SPS volunteers provide an encouraging learning atmosphere and supply students with a take-home activity or craft related to the lesson. Since CIS adds a new grade each year, the after school program at the school has grown significantly (by about 30%). The larger number of students and the increased age difference require the readjustment of the outreach program. One idea is to separate students into small groups by age, with age-appropriate activities for each group related to the central lesson theme. This would allow us to challenge kids of each age appropriately and keep active participation for all the students. The proposed change requires additional materials and preparation time.

In addition CSU's SPS will invite students from CIS to CSU's physics department. SPS students will organize on-campus physics demonstrations and engaging activities for the CIS kids during their field trip to CSU. This daytime trip will allow us to reach out to more CIS students through captivating demonstrations at CSU's physics department.

Our Physics Club Promotes an Interest in Physics

Our past spring outreach programs have each followed a physics theme such as "Making Waves," "Finding Forces" or "Investigating Phases." Throughout the spring semester these themes were explored through several relevant lessons and reinforced with fun and educational take home activities. Each lesson plan we develop includes large group demonstrations followed by small group activities (proposed now to be separated by age group). To summarize the day's lesson we finish with a large group wrap-up activity. Students are encouraged to ask questions, input ideas, observe attentively, and participate with the demonstrations.

Each meeting revolves around a central theme, but the SPS volunteers have to apply broad knowledge of physics to make our explanations accurate, yet relatable to our young audience. It is rewarding to see the students use physics to understand why the demonstration is working and predict what can happen under different conditions. It is great to see "veteran" CIS students excited for another lesson in physics and eager to contribute to the lessons with ideas they have learned from our past outreach activities.

Our theme for this year focuses on how we encounter physics every day. Specifically, we will explore the presence of physics in the seemingly mundane moments of a school student's day. Hopefully this explanation will intrigue the students and nurture their curiosity about the role of physics in their everyday lives.

Detailed Plan

- Personnel – CSU SPS faculty advisor Dr. Kiril Streletzky coordinates the events with six-ten volunteer CSU students and CSU Department of Physics staff. Our outreach coordinator, Chris Mentrek typically leads a team of long term SPS volunteers (Janna Mino, Jim Pitchford, Liz Brouchu, Marie Blatnik, Krista Freeman, Rich Kolk) in creation of a specific plan for a CIS visit.
- Marketing – Coordination with other SPS events on campus and flyers provides open invitation for volunteers. Coordination with CIS faculty invites parents to participate in after school physics club.
- SPS member participation – Most of the student volunteers are SPS members. Additional help comes from other science and education majors.

- Expertise – Many of our returning volunteers have been participating since the beginning of the program, including Chris Mentrek, Krista Freeman, and Jim Pitchford. The students recognize and respect them. These veteran volunteers pass their valuable outreach experiences and knowledge on to the new volunteers to ensure a smooth transition for the program.

This year's theme will be explored through the following lessons:

January: "Waking Up in the Morning: How Does My Refrigerator Work?"

This lesson introduces volume and its relation to temperature and pressure via: demo of a cooling effect of a drop in pressure; the heating effect of increasing a gas' pressure; and a role-play model of hot gas. In addition, a heuristic model based on a balance allows students to see the inter-connected relationship between pressure, temperature and volume.

February: "Going to School: Field Trip to CSU"

The trip will include a variety of elaborate physics demos in mechanics, E&M, and optics at the Physics Department of CSU; physics-related drawing challenge, pizza with physics students and faculty

March: "Recess Time: Simple Machines on the Playground"

This lesson focuses simple machines using hardware-store components (inclined planes at various angles, levers, pulleys, and wheels). Students are presented with tools and challenged to identify which simple machines make up parts of the larger tool. Students take home a wheel-and-axle contraption constructed from cardboard and drinking straws.

April: "Rainy Drive Home: A Rainbow is the Silver Lining!"

The lesson will include a discussion of the "ingredients of rainbow," demonstration of light dispersion by a prism, exploration on how laser light travels through a Jello model of a raindrop, making a rainbow with a pump misters, and building CSU spectrometers.

May: "Lights on for Story Time: How Circuits Work"

The lesson will use Van de Graaf generator and Jacob Ladder demos to illustrate charge production, electrostatic kits (with balloons of course) for kids to play with and conductive playdoh challenge to light up the reading lamp.

Sample Lesson Plan (by Chris Mentrek) : Make A Rainbow!

SPS Outreach: Make A Rainbow!

Students will learn:

- White light is composed of many colors
- Different colors of light bend in different ways when passing through objects
- Water droplets can bend light to form a rainbow
- Where to stand in order to view / form a rainbow (i.e. the recipe for a rainbow)
- The order of colors in a primary rainbow
- Scientific study "rainbow" to learn what objects are made of. This is called "spectroscopy."
- How to make their own spectroscopes, which are taken home.

Supplies:

SPS	Chris
Bright white light source (portable projector or slide projector?)	Rainbow chalkboard
Yacht scooters	Spectroscopy worksheets
Red and violet laser pointers	DVD-R diffraction gratings
Prism (to illustrate dispersion)	Transparent "Scotch" tape
Optional: Various light sources (to be viewed with spectroscopes)	Pump misters (or water droplets)
	Jello model of "water droplet"
	Lego figures to demonstrate color paths
	Optional: rainbow PowerPoint presentation with photographs of rainbow

Activities:

- 1. Introduction:** Gather students in a group. Ask if they have ever seen a rainbow. Where did they see it? What was the weather like? Was it day or night? (Accept all answers.) Ask students to guess what "ingredients" we might need to form a rainbow. Try to arrive at the conclusion that we need:
 - Sunlight
 - Water droplets in the air
 - Eyes to see
 - The proper place to stand
- 2. Light is Made Of Colors:** Reinforce the "Rule Of View" from previous class session: "Humans don't see things. We see the light that comes from things." Demonstrate the

dispersion of white light into colors using a prism.

- 3. Colors Travel Differently:** Demonstrate that different colored lights follow different paths by shining two laser pointers of different colors (two different paths) through a prism (Jello or model of a raindrop). Ask the students to guess what colors they would see from different pieces in the model, using the Lego figures as a guide.
- 4. Making A Rainbow:** Now that we know the ingredients of a rainbow, and how light can separate into colors that travel in different directions, we're ready to make a rainbow. Using perforated pump misters (which make a cloud of tiny droplets without spraying enough water to make a mess), challenge the students to make a rainbow using the projectorlight source.

Guide students to the conclusion that they must face AWAY from the light source and create a cloud of droplets in front of them in order to see a rainbow.

(Optional: If the weather outside is sunny and warm, consider taking the group outside at the end of the lesson in order to make a rainbow from sunlight.)

- 5. Make A Spectroscope:** Show students that a rainbow can be made by bouncing light off of a CD or DVD, and explain that this is because the disc contains tiny lines called a diffraction grating. Demonstrate that we can break a DVD apart to separate the grating from the rest. (Make it as destructive as possible.)

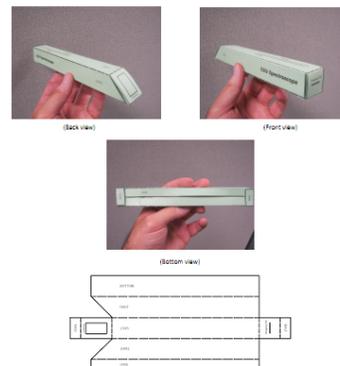
Explain that scientists use spectroscopes to make "rainbow" colored spectra from different light sources, and that this is a major tool in science. Spectroscopy was science (like the students) figure out what different light sources are made of.

Tell students that they will be assembling their own spectroscopes, and seal them with the tape. Each spectroscope kit contains a piece of the diffraction grating from a DVD-R disc, and a foldable paper pattern to make a dark tube with an illumination slit. Help the students cut out the pattern, fold the ends into a tube, and attach their diffraction grating to the viewing end.

Help the students to view different light sources with the spectroscopes, and comment on what they see.

SAFETY CONCERN: Stress that students should NEVER use their spectroscopes to look directly at the Sun – this can permanently injure their eyes. Instead, have students face AWAY from the Sun, and examine the sunlight reflected by a white piece of paper.

SPS Outreach at Campus International School:
Folded Spectroscope Examples:



Activity Evaluation Plan

- Our current attendance is about fifty students, who are in their after-school program at CIS. To increase the interest in Physics club this year we will host a visit of CIS students at the Physics Department. Careful records will be taken for each event.
- Although a survey is not practical for our audience due to their age, a reasonable evaluation would be for parents to fill out a quick survey after talking to their children about our activity and/or completing a take home activity. A survey of the CIS faculty is a possibility too.
- We will survey SPS volunteers who contribute their time to the Physics Club.
- The best feedback we receive is the heartfelt enthusiasm and participation of the students when they explore the wonder of physics. The can not wait for another visit of the CSU Physics Club.

Budget Justification with Timeline

Month (2014)	Theme	Supplies/Expenses	Cost
January	Waking Up in the Morning: How Does my Refrigerator Work?	Student-safe thermometers for students to keep (\$75), 4 cans of compressed-air "computer duster" (\$8), bicycle pumps (\$30), Pegboard, wood&hardware nuts (\$13)	\$125
February	Going to School: Field trip to CSU	Physics Dept's equipment and financing	\$0
March	Recess Time: Simple Machines on the Playground	Pulleys (\$24), Lumber for inclined planes and levers (\$20), Dowels and rods for wheel-and-axle construction (\$16)	\$60
April	Rainy Drive Home: A Rainbow is the Silver Lining!	Projector, laser pointers, prism, gas light sources (CSU), 40 pairs of scissors (\$20),Jello supply(\$5), DVDs (\$10), pump misters (\$20), scotch tape (\$5)	\$55
May	Lights on for Story Time: How Circuits Work	Balloons (\$5), playdoh (\$15), light bulbs (\$20), batteries (\$20), combs, CSU demo equipment	\$60
TOTAL COST			\$300