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

Marsh White Award Report

Project Proposal Title	Reinventing a bicycle discovering physics via a common object well known to every kid
Name of School	Cleveland State University
SPS Chapter Number	1247
Project Lead (name then email address)	Dr. Kiril Streletzky K.STRELETZKY@csuohio.edu
Total Amount Received from SPS	$300.00
Total Amount Expended from SPS	$300.00

Summary of Award Activities

The SPS chapter of Cleveland State University (CSU) organized and conducted a physics outreach program for students in the YMCA afterschool care at the Campus International School (CIS) —a public K-6 school in downtown Cleveland. The underlying outreach was to unify outreach lessons and hands-on activities with a common object easily accessible to elementary & middle school children—a bicycle. Our interactive and hands-on demos helped us to build physics intuition, motivate the students to learn and spark their interests in discovering how physics allows a bicycle to work. The children never wanted us to leave; they were too enveloped in the mindsets of experimentalists.

Statement of Activity

Overview of Award Activity

The outreach program at CIS was based on exploring the physics of a bicycle and consisted of 6 content modules: 1) Center of Mass; 2) Wheels; 3) Rotation; 4) Energy; 5) Friction, and; 6) Simple Machines. The first visit to CIS (early Feb) was dedicated only to a Center of Mass module. The Wheels and Rotation were combined into the second outreach lesson (late March) while the modules of Energy, Friction and Simple Machines were taught during the third visit (early May)

Each lesson, then, was delivered via interactive activities and demos taught within a 1.5-2 hour time period at Campus International School (CIS). CIS is a public school located in the Cleveland Municipal School District. CSU's SPS has been conducting outreach events at the CIS afterschool care program (ran by YMCA) since Spring 2011. The after-school program has been ever-growing, currently serving 65 students in all CIS grades—between kindergarten and sixth grade.

Typically, each event would start with our advisor, Dr. Streletzky, performing a catchy demo to introduce the theme(s) of the day to all the kids. After this main demo, we divided the kids into four age-appropriate groups (K, 1-2, 3-4, 5-6) with a goal to deliver to each group age-appropriate interactive learning activities based on the theme of the day. The four groups would rotate between four specific "stations," each run by 1-2 members of CSU's SPS. Each "station" would have a learning component key to the overall lesson theme of the day. The information at the stations was delivered at a somewhat different level/pace to a corresponding age group. Kids would also be given an educational toy as a take away present from each lesson.

In the end, we managed to spark curiosity and an excitement to discover the physics that revolves around bicycles. This was indeed the goal, with hopes that these kids would take this curiosity and begin using their developing physics intuition to look at the world in a different light. Seeing the gears in their heads turn as they interacted with the demos was proof that we were having the intended impact. Their interest in the lessons and their enthusiasm for answering questions and participating in thought experiments were very rewarding!

In particular, all of us experienced the following story in one form or another throughout the semester: imagine yourself in the 4th rotation of students during a particularly busy lesson. It can be somewhat exhausting! But in that 4th rotation something special happens—one of the youngest students, who you notice has been taking notes during the lesson, looks up and says to you "I want to be a scientist when I grow up!" … now THAT is the reason that we do this!

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

Before every outreach event, the outreach team would meet and discuss the lesson plan of that particular event. Such discussions would focus on the interactive demos at each station, whether or not they would be able to work with the children of CIS' age group, if they would fulfil the requirement of promoting an interest in that particular physics phenomenon, and so on.

During the events, we would keep a much updated photo record of each station, in addition to a few videos. Post-event, the team would meet again and discuss the success of that particular day. Such assessment included determining if the demos were successful in grabbing the attention of the kids and if the teaching approaches were useful in keeping the attention of the kids. We also asked the YMCA aftercare personnel to reflect on the type of reactions to the outreach lessons given back by CIS students.

Among this, we also asked for feedback from the kids themselves. In pursuit of trying to find how they felt about the outreach program as a whole, most replied with how much they wish they could be like us, have us stay for longer, and so on. A few even said they wanted to attend Cleveland State University to study science and physics. Those statements, alone, were very uplifting and reassuring that we were really doing something right!

Finally, the outreach team participants (SPS members) were asked to complete a quick survey to estimate the impact of the activities on SPS/outreach members. All of the responses were overwhelmingly positive, highlighting the three important outcomes: a) inspiring nature of outreach activities to curious CIS kids and significant positive role in promoting their interest in science/physics; b) often unexpected realization that the

outreach lessons promoted SPS volunteers own interest and sometimes better understanding of physics; c) positive role of the outreach efforts as the community building exercise for SPS chapter.

Key Metrics and Reflection

Who was the target audience of your project?	**Students in grades K-6**
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 4-6**
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. However, since the outreach is a year long activity additional funding for the fall outreach would be very useful.**
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" themed outreach beginning this fall. A project-based year-long school day activity for 5th and 6th 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 activites with students from 5,6,7 grades**
If you were to do your project again, what would you do differently?	**We would try to recruit more CSU/SPS students to be able to better handle the 60+ kids.**

Press Coverage (if applicable)

Expenditures

Expenditure Table

Item	Please explain how this expense relates to your project as outlined in your proposal.	Cost
Markers and colored cardboard supplies	Suppiles for Center of Mass module activity "Find the CM of Ohio"	13.91
5 pkgs of 12 Balancing birds toys and 7" balancing eagle Demo	Center of Mass module give away presents and the lesson demo	44.24
Aluminum Cycle Pro Mechanic Bicycle Repair Stand Rack Bike	Center of Mass, Wheels/Rotation, Simple Machine demos	99.00
BIKEHAND Bike Bicycle Repair Tools Tool Kit Set	Important sent of aids and demos for Simple Machines and Friction modules and overall usuful set to illustrate how bikes work	55.71
Learning Resources Simple Machine Set and 4 bags of Large Poppers	Interactive demo for the Simple Machine module and Give away presents for Energy Module	62.85
CatEye Velo 7 Bicycle Computer CC-VL520	Energy and Simple Machine Modules Demo	21.25
	Total of Expenses	296.96

Activity Photos

Halloween Spooky Physics Show (Oct 14) team. Dr Streletzky, Jim Pitchford, Ilona Tsuper, Dan Terrano, Christian Gunder, Krista Freeman, Grace Gaeckle

Spooky Optical Illusions (Oct 2014)

Fiber Optics Crystal Ball

Liquid Nitrogen – an important part of Spooky physics

Center of Mass team (Feb 15): Krista Freeman, Dan Terrano, Ilona Tsuper, Dr Streletzky, Christian Gunder, Margaret, Jim Pitchford

C.o.M of simple objects: Rulers

C.o.M of complex shapes: The state of Ohio

C.o.M of variable shape/size objects

C.o.M: Mass Distribution of a human body. Stand up straight challenge

Wheels & Rotation Lesson team: Dan Terrano, Ilona Tsuper, Jim Pitchford, Dr Streletzky, Christian Gunder, Krista Freeman

W&R: Table Tops

W&R: Comparing Rolling Objects

W&R: Angular Momentum and spinning

W&R: Rotational Inertia Demos

W&R: Initial Demo with a bike

Energy, Friction, & Simple Machines Team: Dan Terrano, Janna Mino, Ilona Tsuper, Christian Gunder, Dr Streletzky, Krista Freeman, Jim Pitchford,

Simple Machines: Levers- how strong the kids could be!

Energy: The Pendulum Challenge

Friction: Hovercrafts race- how can we change friction

Friction: Material Dependence of the Force of Friction

Simple Machines: Pulleys & Winches & Cranks

Bringing it all together on a Bike (Center of Mass, Wheels, Rotation, Energy, Friction, & Simple Machines):

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