

Marsh W. White Award Proposal

Project Proposal Title	Renewing Physics Demonstrations for Community Outreach
Name of School	University of Maine, Orono
SPS Chapter Number	4043
Total Amount Requested	\$500.00

Abstract

Our chapter and physics department actively involve themselves in promoting study of physics to pre-university students in our local community and across the state of Maine. In the proposed project, our members will design and build portable physics demos to aid in these efforts, as well as renovating existing demos.

Proposal Statement

Overview of Proposed Project/Activity/Event

Both inside the classroom and out, intriguing demonstrations which surprise the senses have long been productive in encouraging scientific interest among students. Our SPS chapter and the University of Maine Physics department as a whole are very involved in performing such promotion across the state, at schools, fairgrounds, and STEM-focused expos. Demonstration tools are inevitably worn down by such active use and find themselves in need of repair, while continuing expansion in size of such events requires that more demonstrations be available for students' enjoyment. With this proposed project, we seek to bring our travelling set of physics demonstrations up-to-date, and to involve current undergraduate students in the design/build process so that they too can benefit from better understanding of important physical principles and of the educational process.

How Proposed Activity Promotes Interest in Physics

Dr. Marsh White was once quoted as recalling that he had not entered college seeking to study english and history instead of physics, until his exposure to faculty in the physics department redirected his attentions. Many in the general public hold an unfortunate conception that some people are simply born physicists, while others are born without the necessary skills and style of thought. By continuing to organize outreach activities to students in the Maine community, we hope that we can persuade more and more students that anyone can develop the passion and intuition necessary for a fulfilling career in the physical sciences. Demonstration tools which illustrate exciting physical concepts are essential for capturing the attention of students at all ages, leading to further conversations which help to develop curiosity in these young minds about the sciences. This proposed project of developing such demos for use by our chapter therefore closely fits the intent of the Marsh W. White Award, and if selected, is guaranteed to help make a difference in the promotion of physics.

Plan for Carrying Out Proposed Project/Activity/Event

The officers of the UMaine Chapter of SPS will oversee this project, in particular the President and the Outreach Chair. All other officers and interested members will have regular involvement in the progress, which will be discussed at our weekly general meetings to confirm a steady pace. A reasonable estimate of SPS member participation is that 8-10 undergraduate members including officers will take part in the demonstration design and construction process. Graduate students and faculty will also be recruited to the effort if their unique skills and experience are called for by the work. Our SPS membership includes students from both the physics and engineering physics programs, who have a wide diversity of skills across all technical disciplines. Their experiences in electrical/electronic design, software development, mechanical craftsmanship, and aesthetics will help to produce robust and effective demos.

The project will consist of three stages. An initial planning stage will be completed before the end of this fall semester, during which participating volunteers are identified during SPS general meetings and also recruited from physics courses at all levels by involved faculty. The second and third stages, described in more detail below in the Project Timeline, will include the renovation of existing demonstrations and creation of new ones, respectively. The bulk of student work will center around turning well-known devices and physical phenomena into interactive teaching tools. As listed in the budget, it is possible to purchase existing tools such as a hand crank-generator or a Newton's cradle, and such items will make up the majority of our costs. However, such a device by itself cannot easily pass on a curiosity for physical understanding to students; our volunteers will have the challenge of accessorizing and automating such tools. In this aspect, the several student members who have been actively involved in physics teaching assistancy will be able to guide others in seeing the demonstration through a less-experience student's eyes.

Project/Activity/Event Timeline

The target for completion of demo development is the first week of March 2018, when the University of Maine will host the annual Engineering Expo. This event brings in families from across the state, and especially children of all ages, to experience technical innovations and see some of the work occurring at Maine universities. Our SPS Chapter has long volunteered at the event in coordination with our physics department, interacting with hundreds of students and families throughout the day. Our presence at the event this year will ensure that the demos built will see immediate use, and will provide a natural testing ground to work out any final bugs that were not caught during the development phase.

During the six weeks between the beginning of our Spring semester and the Expo, distinct teams of 2-3 members will each design, implement, and test a demonstration or set of clearly-connected demonstrations. These teams will be determined prior to the end of the Fall Semester in mid-December, in order to hit the ground running in January. The first week will serve as a build-up week in which the proposed repairs and renovations of existing demos, likely an easier process than design of new demos, is completed and teams are thereby inspired towards ideas for their own demonstration. Teams will interact together at our weekly SPS general meetings, and update the membership on their progress and any additional skills for which they seek volunteers. This interconnected design process will allow all teams to benefit from their combined technical experience, as well as ensuring that no demo lags behind the others in progress towards the March deadline.

Activity Evaluation Plan

The direct success of this project may be measured simply by evaluating the functionality of the demonstrations developed. However, much more meaningful is the subsequent indirect effects of benefits conferred to area students whose exploration of physics is enabled.

The primary available metric at public STEM-awareness events such as our university's Engineering Expo is the quantity of visitors/participants. By comparing number of total participants who visit the physics demonstrations with that of previous years, the total improvement resulting from this project can be assessed. This evaluation can also help to identify which demonstrations are more popular with students and therefore more effective than others, allowing for continued refinement of the products.

Budget Justification

The UMaine SPS chapter finds that upper elementary and middle school students enjoy seeing and experiencing a Van de Graaff generator. With heavy use for outreach events, the lecture room apparatus often end up with broken belts. We propose to purchase 2 spare belts to make up for when the belt breaks on our outreach events.

With the use of lights and spectral supplies we're able to share with children how light is made by letting them look through diffraction glasses. Unfortunately, they're often disappointed when we can't let them take them home for further experimentation, so we propose to develop a "take home experiment" to study light sources in their home, which will supplement the existing colored light sources we can bring for demonstration.

Three new demonstrations which we plan to develop for our chapter outreach activities are specified here.

First, a hand crank generator has been very successful in the classroom in explaining how electricity is generated. The largest cost associated with such a demonstration is the generator itself, while project volunteers would work to produce circuitry and visuals which give students the maximum benefit of the equipment.

Second, a Newton's cradle would be the centerpoint of a new demonstration describing mechanical energy and conservation laws. Necessary student work might include some extent of automating the cradle for easy tabletop use, and developing a system of add-on weights to enrich the discussion of momentum.

Finally, obtaining handspun helicopters to use as a sample of flight can lead into discussions about how drone copters work, which can be supplemented by the expertise of student members who are involved with drone work performed in one physics department group.

Our physics department's lecture apparatus facility will cover any additional shipping or processing costs beyond the proposed amount.