



# SOCIETY OF PHYSICS STUDENTS

An organization of the American Institute of Physics

## Marsh W. White Award Proposal

Project Proposal Title	A “Laser-Focused” Approach to Optics Outreach
Name of School	Appalachian State University
SPS Chapter Number	0216
Total Amount Requested	\$500

### Abstract

Appalachian State University’s SPS chapter will emphasize optical concepts in their outreach by incorporating a variety of entertaining and interactive elements. This project will construct multiple laser-based demonstrations with integrated safety features for the purpose of bringing optics to a wider audience.

### Proposal Statement

#### Overview of Proposed Project/Activity/Event

The proposed project will construct the following demonstrations to be used at outreach events across North Carolina.

**Laser Balloon Popping:** The chapter will construct a durable and portable container to house a set of three lasers (red, blue, and green) for laser balloon popping. The lasers will be controlled by external switches and powered via an extension cord connected to a wall outlet. Volunteers will use this apparatus to demonstrate the concept of light absorption by shining each of the colored lasers on a variety of clear and colored balloons.

**Fluorescence:** Students will design and build adaptable stands that allow lasers to be easily locked in place for safety and removed when necessary. Lasers will be permanently pointed down when mounted in the stands. These stands will have a space where non-reflective materials can be inserted under the laser for observation, but the space will be small enough to remove the risk of someone shining the laser in their eye. The chapter plans to provide an assortment of fluorescent and otherwise interesting materials for people to experiment with at outreach events. Safety stands will help parents feel comfortable allowing their younger children to interact with the exhibit, thereby expanding the target audience. The stands also allow volunteer demonstrators to focus on explaining the science and interacting with the audience rather than primarily managing laser-related risks.

**Total Internal Reflection:** The chapter will create a total internal reflection demonstration by mounting a light pipe and a laser to a stand to create one solid piece. The exhibit will allow an audience to see how light “bounces” through a pipe due to reflection. Once this concept has been made clear, demonstrators will shine a laser through a hole on the side of a two-liter bottle filled with water to show how the light is reflected within the stream of water that flows out.

The project will also include purchasing some table-top optics materials to demonstrate principles of refraction and reflection to smaller audiences. By prioritizing safety without sacrificing entertainment, this chapter hopes to enhance the local community's interest in and understanding of optics.

### **How Proposed Activity Promotes Interest in Physics**

Optics is one of the most underrepresented facets of physics in demonstrations. The main reason for this is because not many demos can be shown in a large-audience setting and need small, hands-on style demonstrations. New optics equipment gives the opportunity to show something different. Seeing something new in physics inspires children to wonder why. Giving them something that breaks their understanding, like light bending, makes them believe there is something more than what eyes can see.

Many demonstrations are difficult to explain without good materials. The county Appalachian State is in, Watauga county, has the third highest child-poverty rate in the state with over 37% of students eligible for the free or reduced-price lunch program. Surrounding counties that the chapter often travels to such as Ashe have similar poverty rates. Giving every child in the area the chance to see physics in ways that they have never seen before because they or their school cannot afford it is of utmost importance.

### **Plan for Carrying Out Proposed Project/Activity/Event**

The design and construction of the various demonstrations will be completed by student leaders in the SPS chapter. The development process will be overseen by Dr. Brooke Hester, an accomplished optical physicist and the current SPS advisor at Appalachian State University. After procuring the necessary materials, the actual construction will take only a few hours or days per activity, and should all be easily completed before the first large outreach event of the spring semester in April 2024.

While only a few SPS chapter members will participate by purchasing materials and physically constructing the various apparatus, far more will interact with the project by presenting the activities at outreach events. The chapter attends approximately 20 such events each year and already has processes in place for training students, transporting materials, and marketing to target audiences. These proven strategies and existing infrastructure will support the addition of optics activities to the chapter's outreach efforts.

### **Project/Activity/Event Timeline**

The outline of the activity timeline is as follows;

January - Order all materials needed on our budget list

February - Begin working on building our laser case and safety stands

March - Test and train SPS members on safety and how to teach children using the demonstration and run practice shows

April - All demonstrations will be complete

April is STEM Education month in North Carolina so Appalachian State has many events throughout the month for outreach.

Having all new equipment ready before this date is essential to these events as many will be focused on the upcoming eclipse where understanding light is going to be a major topic.

May 31 - Deadline for final report

## Activity Evaluation Plan

The chapter often receives feedback from teachers about the particular demos that their students found most exciting. One measure of success would be receiving this kind of feedback about the newly introduced optics demonstrations. Another key metric is participant engagement. When putting on shows, presenters frequently ask for volunteers and base future demonstration choices on how many people were excited to participate. At booth-based events, engagement can be measured by how many people stop and whether they stay to complete an activity. The overall success of this project will be evaluated based on a combination of these qualitative and quantitative measures. A final report will be created at the end of the spring semester 2024 to inform decisions about the inclusion of these demonstrations in future outreach.

## Budget Justification

The project will be a long-term effort with the potential to be scaled significantly. The lasers, optics kits, internal reflection pipe, fluorescent materials, and balloons will all be used to promote excitement and engagement with optics. The other materials, such as the laser stands and housing container, are included because of the chapter's commitment to safe practices. The quantities of materials listed are necessary to support the project through its initial stages and allow the chapter to fully test the concept's viability. Once the concept has been proven, the chapter will use its existing fundraising methods to slowly add additional materials, expanding both the reach and impact of the project.