



# SOCIETY OF PHYSICS STUDENTS

An organization of the American Institute of Physics

## Marsh W. White Award Proposal

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<b>Project Proposal Title</b>	It's Getting Hot in Here!
<b>Name of School</b>	Cleveland State University
<b>SPS Chapter Number</b>	1247
<b>Total Amount Requested</b>	\$498.95

### Abstract

The Cleveland State University SPS chapter will travel physically or virtually (due to COVID) to the local Campus International School (CIS) a K-8 public school in Cleveland and perform physics demonstrations for the students there. Inspiration for this project comes from a deep desire to spread the love of physics and encourage elementary students to consider physics as a future career. Specific motivation comes from amazing talk and demonstrations by Dr. Bill Phillips at Brown University during PhysCon 2019 that several members of chapter attended.

# Proposal Statement

## Overview of Proposed Project/Activity/Event

Physics Fridays will involve a variety of Cleveland State University SPS current members and alumni traveling (in person or virtually due to COVID) to a local K-8 public school, Campus International School (CIS), to perform physics demonstrations for the students. We typically make it to the CIS about three or four times per semester. These demonstrations encompass a wide array of physics phenomena, with past semesters having themes such as fluids or sound. This year's theme will be "It's Getting Hot in Here!", an examination of the physics of temperature, heat, and pressure. The motivation for this year's theme is actually from Dr. Bill Phillips amazing talk and demonstration at Brown University during PhysCon 2019. We will be drawing some demonstrations directly from his talk, such as stuffing lots of balloons into a small container with liquid nitrogen, while also expanding to new demonstrations. These demonstrations will give students an opportunity to experience hands-on the physics of temperature and heat. The students will have be given a chance to form hypotheses about how all these processes work and how they relate to a greater understanding of physics. This will develop an appreciation of physics and the scientific method before the students get into late middle and high school education.

The main goal of this project is to inspire students with a love of science through our demonstrations. We hope to instill in the students a feeling that they, too, could one day make their own scientific discoveries, creating a possibility that they will continue a lifetime of scientific discovery and hopefully become great physicists (and future SPS members!) themselves. The intended audience will be K-8 school students at the CIS. This project was devised out of a common goal at Cleveland State University to spread the love of physics throughout this world, and to hopefully inspire many young students to consider physics and STEM in general as a long-term career path.

In this global pandemic situation, many (if not all) in-person activities might to have to be put on hold. We have two choices in how to handle this: first, postpone the outreach until in-person interaction is approved (not ideal), or, two, take advantage of the scheduled virtual club time in CIS on-line learning schedule and deliver the outreach lessons via ZOOM or Teams. This second choice is how our SPS chapter would like to handle this situation. On Wednesdays, students at Campus International have a few hours(11am-3pm) dedicated to club activities. Our Marsh White proposed outreach lessons will be adapted to be delivered online in this situation. Further, we will assemble some thoroughly disinfected and quarantined science packages and distribute them to the students so they can follow along and experience the phenomena hands-on. This will be accomplished through the distributing some of our demo materials (e.g. the thermochromic crystals or chocolate chip melting contest) by mail to students before the outreach in preparation for our science lessons.

## How Proposed Activity Promotes Interest in Physics

This project is defined by its stated goal to instill a love of physics and scientific discovery onto the young minds and future scientists at the Campus International School. We at Cleveland State SPS work hard to share our love of physics with everyone around us, but K-8 students are of particular value. While it may be hard to convince a 19-year-old biology major that physics is actually better, it is much easier to show the joy of discovery in physics to elementary and middle school students. This is accomplished through not only the demonstrations but also by encouraging active participation in these demonstrations.

Students are always encouraged to ask questions and form hypotheses about what they see in the demonstrations. Further, we try to always draw connections between the physics demonstrations that we do and the experiences that these students might have during their normal lives. Finally, we always leave the teachers and parents with some resources to keep their students interested in physics. We are never too far away if they need our help advocating for interest in physics.

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

- **Key Personnel**
  - Samantha Tietjen, Physics 4+1 student, SPS President
  - Andrew Scherer, Physics and Environmental Science Major, SPS Treasurer and Outreach Coordinator
  - Dr. Kiril Streletzky, SPS Advisor and Outreach Supervisor
  - Jim Pitchford, 2011 Math Alum from CSU, one of the co-founders of our SPS outreach.
- **Marketing**
  - Similar to the previous year, school staff will be notified of events a least two weeks prior to the event. Staff will continue to communicate this info to students and parents. In addition, Mrs. Kate Grizlack (Assistant Principal, CIS) will help to coordinate our activities.
- **SPS Member Participation**
  - In addition to key personnel, 5-10 other students (physics, math, engineering majors) will join us in our efforts. Many are national SPS members, as our chapter rewards a yearlong outreach with a paid SPS membership.
- **Expertise** – Several members of the earlier outreach team will help us in our efforts:
  - Dr. Krista Freeman, 2011 Physics Alum, CIS Physics Fridays outreach co-founder
  - Tara Peppard, CSU Lab Manager

## Project/Activity/Event Timeline

We will be planning on hosting four (most likely virtual) events throughout the spring semester with CIS:

- I. **Temperature and Pressure (February 2021):** An examination of the effects of temperature on volume and pressure. This will include stuffing lots of balloons into a cooler filled with liquid nitrogen, popping balloons by heating up the air inside, crushing cans and yardsticks with the pressure of the atmosphere, and using a Magdeburg sphere to show the pressure of our atmosphere.
- II. **Evaporation, Condensation, Convection, and Conduction (March 2021):** Looking at the processes and effects regarding those four phenomena. We will show this through demonstrations such as distilling muddy water with evaporation, using dye to show the effects of convection in heated or cooled water, finishing off with a chocolate chip melting experiment (hopefully parents won't be too mad about the mess)! Dye, chocolate chips, and melting materials will be mailed to students before the lesson in case of remote delivery.
- III. **Metals (April 2021):** The focus will be on how temperature and pressure affect metals. Specific demonstrations will consist of melting gallium in students' hands, levitating a magnet, and showing the pressure of light with a radiometer, among others. Gallium metal will be given or sent to students in case of remote so they can play with a melting metal!

- IV. **Liquid Nitrogen Physics Day (May 2021)**: Always a highlight of the student's year, this demonstration will focus on cool stuff to do with liquid nitrogen (like breaking a flower and rubber bands like glass) and end with our famous liquid nitrogen ice cream party – obviously a student favorite. New for this year, this will be a remote demonstration coupled with a lesson on making a homemade ice-cream using only materials available at home. The students will get an excuse to make ice cream with their parents, as well as get a fun piece of thermochromic crystals that change color with temperature sent to them.

## Activity Evaluation Plan

The outreach events will be carefully documented via: 1) lesson plan outlined and detailed for every outreach event; 2) photo-reports with multiple rehearsals from CSU and subsequent activities at CIS; 3) careful archiving of each of the activity's selection of equipment; 4) recorded number of kids and their respective grades for each activity; 5) surveys will be handed out to faculty, parents, and students to assess the overall effectiveness of our efforts. Moreover, outreach members will also be given a quick survey to assess the impact of the activities on themselves.

## Budget Justification

The equipment listed here will give students a hands-on experience, which will help accomplish the main goal of the project: inspiring a love of physics through hands-on demos. The IR temperature scanners will be used throughout the project to show temperatures in a variety of demonstrations. The yard sticks will be crushed with a newspaper to demonstrate the power of the atmosphere. The balloons will be used to show the effect of pressure on volume. The neodymium and ceramic magnets will be used to make a floating top, which was inspired by Bill Phillips' demonstration. The Magdeburg hemisphere and vacuum pump will be used to show the power of the atmosphere, giving students an opportunity to try to pull it apart against the pressure holding it together. The radiometer will give them a first-hand view of the very weird concept that light exerts a pressure too. The ice cream supplies will be used in conjunction with liquid nitrogen provided by the CSU physics department to make liquid nitrogen ice cream at the end of the semester, a student favorite – with students following along at home and making their own ice cream (no LN needed). Most of the demos will have some supplies contributed by the CSU physics department, most notably the liquid nitrogen for the ice cream. The following will be sent to students in a package ahead of the demos: gallium metal (to melt in their hands – completely non-toxic and safe for young students), food dye (to show convection/fluid flow), chocolate chips and insulation/conduction materials to melt, and thermochromic crystals for the students to play with! The jars will be used to contain all the items we are shipping (e.g., chocolate chips and gallium).