



SOCIETY OF PHYSICS STUDENTS

An organization of the American Institute of Physics

Marsh W. White Award Proposal

Project Proposal Title	Cataloguing Old Physics Demos and Creating New Ones (on Fluids)
Name of School	Cleveland State University (CSU)
SPS Chapter Number	1247
Total Amount Requested	\$500.00

Abstract

After cataloguing more than 60 demos from 54 SPS *Physics Friday* outreach events conducted at Campus International School (CIS) since 2011, we organize three new fluid related *Physics Friday* events. In addition, we bring CIS students to CSU to enjoy demo highlights from the updated library of the *Physics Fridays*.

Proposal Statement

Overview of Proposed Project/Activity/Event

In 2011 CSU's chapter of SPS established an outreach program called *Physics Fridays* at Campus International School (CIS), a local K-8 Cleveland public school. Since then, physics students, CSU alumni, and Dr. Streletzky have gone to CIS once a month through the academic year for an interactive physics exploration session with CIS students. The outreach program, which typically serves 30-50 kids in the CIS afterschool program, has won several *Marsh W. White* Awards from the National SPS. These awards have supported the significant part of the spring activities in the year-round program. Over the years, we have created a variety of fun and exciting inquiry-based lesson plans to engage kids with physics/science. Since its inception, we have had 54 *Physics Friday* sessions at CIS, each consisting of three or four different demo stations. Many of the outreach visits followed unique lesson plans, with no particular outreach session repeated more than 3 times (and even in instances of lesson repeats, some of the activities were always new). The lesson plans were created by the current SPS outreach coordinator (we have been led by 5 excellent coordinators since 2011) and their team of volunteers. Since 2011, more than 45 CSU students have participated in outreach lesson creation and execution.

Thanks to SPS funding and help of the CSU physics department, we have acquired, collected, designed, and built more than 60 different demos. At this point, our outreach program materials are in need of systemization, organization, and documentation. The demos need to be carefully stored and, more importantly, carefully catalogued and curated. While CSU physics provided SPS outreach with some storage cabinets, we are in desperate need of sturdy storage bins in which demos can be stored and transported to outreach events. For that purpose, we request funding for the storage bins and labelling supplies. Likewise, we have started creating an easily accessible bank of historical outreach lessons and detailed demo descriptions. This demo bank will be kept up-to-date electronically via online filing system to store lesson plans and materials needed for reference use. We will also create several physical copies to serve as a resource and inspiration for the current outreach team. To complete this effort, we request funding for office supplies (binders, dividers, page protectors). Old demos that will not be used will have their materials repurposed for the current fluids related demos, and will then later be stored with their original supplies. Once cataloguing is completed, three Physics Friday outreach events will be organized.

The first outreach event ("Water" themed), will emphasize water's unique properties. The demo *Supersaturation of Water with Sodium Acetate* will teach about water's property as a solvent while giving them reason to hypothesize why hot water can hold more solute than cold water. The crystal formation at the end will also grab students' interest. The *Electrolysis of Water* demo will prove to students that water is made up of hydrogen and oxygen. Students will wonder why electricity deconstructs water. The *Completing Circuits Using Water* demo will feature two pots filled with water (one de-ionized) used to complete circuits to small LED lights. Students will hypothesize why one pot conducts electricity and the other does not. They will test their hypothesis when a volunteer adds salt to the de-ionized water, allowing electricity to flow. Finally, the *Density of Liquids* demo will let students compare the density of isopropyl alcohol, water, and cooking oil by seeing which one floats on top of the other.

The second event ("Air" themed), will allow students to: a) draw parallels between air and water and b) discover some of air's properties. The *Vacuum Chamber* demo will show how helium filled balloons react in a vacuum chamber. As the balloon falls, students will hypothesize why the balloon stops rising and falls when the air is sucked out around it. The *Density of Gases* demo will draw comparison to earlier the *Density of Liquids* demo. Balloons filled with helium and Sulfur hexafluoride, respectively will rise or sink in the air. To visualize the gas's density, sulfur hexafluoride will fill a small container on the ground. Students will observe that low density objects can float on top of this gas. The *Compression of Fluids* demo will demonstrate not only how a compressed gas can do work, but also challenge students to come up with examples of compressed fluids in their everyday lives (e.g. spray cheese, shaving cream).

The final outreach event (“Weird fluids”), will introduce a larger variety of fluids with interesting properties. The *Normally not Fluids* Demo will allow students to observe a chunk of gallium melting in the palm of a CSU student hand, demonstrating a metallic fluid. Students will also observe liquid nitrogen being poured into a bowl and watch as it evaporates away into a gas. The *Non-Newtonian Fluid Demo* will give students hands-on experience with a non-Newtonian fluid made from corn starch. Students will test what happens when the fluid is gently pressed against vs when the fluid is pressed hard. Students will compare this fluid to other thick fluids like honey and observe their different properties, as well as hypothesize why these differences occur.

After reviewing the demos in our Outreach library, a final event will be held at CSU’s physics dept, featuring highlights and favorite demos of SPS outreach. Special focus would be on larger activities that are best done on the CSU campus, such as the Ruben’s tube. The day would feature hands on demos in CSU’s optics lab, teaching labs. and SPS lounge. It will end with a pizza and the ever-popular liquid nitrogen ice cream demonstration. This event will target a younger group of students, 4th through 5th grade, which will require further coordination with CIS. We feel this event will serve well as a means to introduce more advanced and spectacular science to the students than we normally can, which is more readily available at a physics department. Our goal is to hold this event in late April or early May 2019.

The CSU’s SPS chapter has held outreach program at CIS for 8 years. It has become a favorite of CIS students and teachers. We are building on our previous successes to plan for more ambitious outreach events. With so many old materials and demos, organizing and cataloguing is long overdue. Doing so will help the chapter to do greater outreach in the future, and will bring more CSU students into the outreach.

How Proposed Activity Promotes Interest in Physics

The goal of this project is to inspire interest in physics education among CSU students and CIS schoolchildren. Funding of this cataloguing effort would allow us to better preserve the contributions of previous generations of physics students to our chapter’s outreach effort. It would also help to sustain our current outreach program by easing the burden of planning new lessons and gathering materials.

The K-8 students in the afterschool program at CIS have participated in many engaging physics lessons. The lessons are built around interactive and exciting demonstrations and small group activities. The students learn physics through hands-on exploration of topics like fluids, gases, density, buoyancy, pressure, etc. Learning through inquiry is an excellent way to get kids excited about science. With large scale demos, students engage with the material as a group and learn cooperatively.

Plan for Carrying Out Proposed Project/Activity/Event

- **Personnel** – Samantha Tietjen (Outreach Coordinator), James Ellis (SPS member), and Jim Pitchford (CSU alumni) will oversee the project. Aubrey Lokey (SPS Treasurer), Mitchel Zito (SPS historian), Krista Freeman (CSU Alum), Dr. Streletzky (SPS adviser) will assist in outreach events.
- **Marketing** – CIS’s after school program advertises the program to its students, which always gathers a crowd of at least 30. Mrs. Kate Grizlack (CIS) will help to coordinate the CSU visit.
- **SPS member participation** – 8-10 SPS members participate with every outreach event. Outreach events are advertised at every SPS meeting as well as through email to SPS members.
- **Expertise** – Jim Pitchford (BS Math, 4 years with science camps at the Great Lakes Science Center), four physics majors (each with SPS outreach experience), and Dr. Kiril Streletzky (SPS advisor).

Project/Activity/Event Timeline

Jan 2018: a) Cataloguing of previous SPS demos/lessons; b) Building/ordering materials for new demos.

Planning for CSU visit by CIS students; c) 1st Friday outreach with “Water” themed demos

Feb 2018: a) Purchasing perishable fluids for 2nd Friday outreach; b) 2nd Friday outreach with “Air and its components” themed demos

Mar/Apr 2018: a) Purchasing and preparing materials for the last demos (e.g. non-Newtonian fluid); b) 3rd Friday outreach with “Weird Fluids” themed demos

May 2018: CSU visit day for CIS students (event title in the works)

Activity Evaluation Plan

As per our previous efforts, pictures will be taken at each in-school event and filed along with detailed summaries of the activities that were done at each station per each visit. Google form surveys will be distributed to parents, CIS teachers, and CSU students to provide feedback. Attendance records kept by CIS can be used to gather data on how many students participated. These numbers will provide a metric by which to compare the event's attendance and student satisfaction with previous events.

Budget Justification

The physics department already contains much of the infrastructure and materials to supply these events, but further funding is required to fill gaps in our office supplies and materials. Sticker labels, 3-ring binders, dividers, and page protectors will help keep new paperwork organized, protected, and easy to reference in the future. The 105 quart, 18 quart, and 6 quart plastic bins will be necessary to store and safely transfer demos of varying size.

Isopropyl alcohol and cooking oil will be used demo to demonstrate how different density liquids interact. Sodium Acetate will be used to supersaturate water to demonstrate solubility. Helium and Sulfur Hexafluoride will be used to demonstrate how gases of different densities behave compared to air. 50mg of gallium will be used to show students an example of a metallic fluid. Corn starch will be used to create a non-Newtonian fluid that the students can experiment with hands on. Plaster will be used to demonstrate a liquid that turns solid in air.

200 Latex balloons will be used in multiple demos. They will be filled with air, helium, and sulfur hexafluoride to demonstrate how varying density fluids interact. Filled with air and helium, they will be placed inside a vacuum chamber to show how changing pressure affects a gas. They will also be used to demonstrate that light material can float on sulfur hexafluoride in a container.

The 1lb silly putty egg and 40 helicopter balloon toys will be used for giveaways to the students after two of the outreach events. These will help create excitement and encourage students to come, as well as provide toys that tie in to the themes of each outreach lesson.

Finally, we ask for some funding to cover pizza and LN2 supplies during the final event at CSU with 4th/5th graders.