



Fresno State Physics Outreach

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Abstract

This poster presentation details the Physics 175TS – Physics Outreach Service Learning course offered at California State University, Fresno, as well as the physics tutoring sponsored through the service learning department. Through service-learning, students will learn effective, safe and appropriate teaching techniques in an actual classroom setting. In addition, it will promote community interest in physics, and other STEM (science, technology, engineering, and mathematics) courses. The main goal of the service-learning course is to assist students in learning to describe the basic laws in Newtonian mechanics, electromagnetism, and thermal physics in precise, concise, and simple languages to educate the general public. From actually performing oral presentations, doing demonstrations, and tutoring physics concepts, students in this service-learning program will be able to associate physics concepts with real world issues and understand the application of the laws of physics they are taught in lectures. In this process, the service-learning students can also stimulate the interest in physical science in the communities they present to. As an outreach mechanism, this program allows for exposure of physics, highlighting the various aspects of physics and the many opportunities that the major offers, such as job opportunities in fields ranging from industry and research to medicine and teaching. In addition to the Outreach course, the service learning department maintains a tutoring program on campus geared at students requiring assistance with their physics courses regardless of their major course of study. Utilizing this avenue, the physics program can foster relations with students outside the major and also aids in recruitment into the physics major or minor.



We ask the students about the science they already know and explain how physics is the root of all other sciences. This picture shows their eagerness to get involved in demonstrations.

Service Learning

- Service learning courses in physics focus on the development of improved oral communication, reinforcement of foundational physics knowledge, and development of teaching skills through service as a peer-instructor in physics, instructing as a tutor or outreach demonstrator. Students also take part in service learning by developing materials and resources that effectively address student misconceptions and knowledge gaps to enhance student learning and understanding.
- The various schools and student bodies that the service learning program and physics outreach course reach range from groups as young as 5th graders to high school. The audience is quite diverse; therefore, each presentation requires ample preparation and skill in order to be accessible to such a wide range of students.
- Before the demonstration we rehearse and practice the presentations. This reinforces basic physics principles, and allows us to better present those physics topics. Rehearsals allow us to adjust to our diverse audience age groups to elicit the best understanding of the physical topics.

Demonstrations and Observations

- Superconductor, Argon/Oxygen in liquid nitrogen,
- breaking racquet balls/flower – States of Matter
- Pipe wrench, fulcrum/board – Torque
- Spinning stool, bicycle tire – Angular Momentum
- Newton's Cradle – Conserv. of Momentum/Energy
- Bed of nails, suction cups, balloon bottle – Pressure
- Ring launcher, electro-magnetic induction – E&M
- Liquid Nitrogen Ice Cream

Each presentation is recorded and many photos are taken. Reviewing the videos of the demonstrations, we can ascertain any mistakes that were made and modify our presentations accordingly. By listening to our explanations we can enhance the future effectiveness by carefully calibrating what we say and our mannerisms to fit a diverse audience. Additionally, each week the outreach students are required to generate a descriptive review of their experience and observations for the demonstrations that were performed. This provides various points of view and allows for a collaborated effort on the outreach program as a whole.



The bed of nails demonstrates pressure. We see Jussi standing on a board on top of Michael, showing the students that even with a significant force on the nails, a large area dissipates the pressure.

Specific Examples:

- One teacher spent the majority of our outreach show testing in the back of the room. The students in this particular classroom were very quiet and somewhat disinterested initially.
- A different teacher was very involved and shared her experiences and teaching methods by comparing the topics she covered and how she explained them. This classroom was very involved in volunteering and answering questions.



We teach students conservation of momentum and energy. Above, Simon demonstrates energy transferred from the basketball to the tennis ball; and below, angular momentum conservation with a student rotating on a stool.

Teaching Techniques

As this course is designed to foster future science teachers, the skills gained in this course are invaluable. From hands on demonstrations to fielding questions from classroom audiences, the experience is crucial for building strong teaching abilities. Outreach students are given real-world scenarios and forced to learn classroom management skills in addition to delivering educational concepts.

Specific Examples:

- A 7th grade student was disruptive and acknowledging the student's behavior made the student act out more. The lesson learned was to tell the student their behavior is not helpful and ask them to be respectful.
- One student from a continuation high school and never studied physics but seemed to have a natural inclination for understanding the concepts. His involvement in our demonstrations showed him something he was good at and we were able to provide answers on possible educational options for him.



Jeraldo demonstrates Lenz's Law by launching an aluminum ring into the air after explaining electricity and magnetism.

Physics Tutoring

Tutoring allows students an opportunity to spend time with physics majors and explain the benefits and difficulties in obtaining a degree in physics, as well as a better understanding of the diverse experiences one can have with research opportunities and growth in the field of physics. Many students are unaware of the various sub-fields and jobs that are available to physics students. Some students have changed their major to physics as a result.



Mechanical advantage, or torque, shows students that with the right proportions of force and lever arm, they can lift their teacher.

Tutoring student athletes provides them with an opportunity to translate the formulas and facts presented in a lecture into an understanding of physical concepts. Many do not have a background in the analytical processes or mathematics requisite to physics: having a physics major working with them to help bridge the gap makes them more willing to engage their work. Athletes are often eager to demonstrate their new-found grasp of physics to their peers, further spreading the impact of the tutoring.

Why Physics?

A regularly asked question from students who have an ambiguous understanding of what physics is often ask, "What can you do with a degree in physics?" It is always a surprise when they receive the answer, "Just about anything." Taking classes in physics opens a student's mind to new ways of thinking about the world, by gaining an understanding of the interactions between objects.



Oxygen in liquid form helps display states of matter



Dr. Pei-Chun Ho demonstrates the bimetallic strip bending as the two metals expand at different rates when the temperature is increased.



We always finish our outreach presentation by making the students ice cream using liquid nitrogen. This teaches the students about the different states of matter at low temperatures.

Conclusion

The CSUF Physics Outreach has gained a lot of momentum within the community, attracting the attention of several media outlets from television to print in just one semester. From the initial conception of this program, and demonstrations to a few schools close to campus, the program now has bookings a semester in advance and the possibility of multiple sections both from demand from regional schools and physics students intent on enrolling in the course. Future goals of this program entail an interactive website that allows resources to teachers and students on a more frequent and accessible basis, and design and development of new demonstrations and presentation techniques. The demand for this outreach program underlines both the needs of the education community and the inherent responsibility to be good stewards of science education. With the addition of the tutoring component of the service learning program, CSUF offers a unique opportunity to build interest in physics, and more generally, science education, at the K-12 level while providing ample support to the students who choose an education in science at the university level. This culminates in a program that catalyzes the spark for science and then helps to maintain educational success to those that pursue it.



Brian explains some of the different aspects of our outreach program during a live interview from a local television station.

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