Elementary Charging (A Lesson on Electricity and Magnetism for 4th graders)

Sonoma State University Society of Physics Students Chapter
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On behalf of the Roseland Elementary School in Santa Rosa, California, and the Society of Physics Students of Sonoma State University (SSU SPS), we would first like to thank SPS National Office for their Marsh W. White award, which allowed SSU SPS to take physics to the classroom of underprivileged kids in our local area.

The goal of the SSU SPS outreach event was to provide an underprivileged elementary school classroom with a memorable science lesson in electricity and magnetism. An additional goal was to create a format for future school outreaches and services that our chapter will perform, for future semesters.

During a lecture given at Sonoma States' "What Physicist Do" lecture series (see http://www.phys-astro.sonoma.edu/wpd/wpdcurrent.shtml), it came to our chapter's attention that many elementary schools in California (especially those in underprivileged areas), have been skipping science lessons in favor of English and Math to keep up with standardized tests. Our chapter believes that elementary school is an important place in which to learn science, due to the enormous curiosity and thirst for understanding that many elementary students possess. Therefore, our chapter contacted local elementary schools and scheduled a visit to a fourth grade class at Roseland Elementary School in Santa Rosa, CA. Our chapter then chose a specific set of demonstrations that we believed the students would understand. We thought it fitting to have students build an electric motor from a battery, wire, and magnet.

The main focus of the outreach was to give the fourth grade audience a hands-on experience in electricity and magnetism by having them build this electric motor. From outreach we also hope to use this experience as a format for more improved elementary school outreach in the future. We hope to ensure that the younger generation continues to explore the sciences, even when their schools cannot.

On March 8, 2013, we began our lesson by distributing magnets to the students and demonstrating how magnets both repel and attract each other depending on which ends are near each other. This was followed by two demos to show and explain magnetic fields, one by sprinkling iron filings near a magnet, and the second by inserting a magnet in a three-dimensional housing with several metal arrows that align them-selves with the magnetic field. Our chapter did this to show that magnets have an invisible magnetic field about them. Next, we demonstrated how electricity can be used to create a magnetic field using an electromagnet. Students attempted to pick up paperclips with a coil of wire and noted that this was only possible when the coil of wire was connected to a battery. Finally, our chapter combined each of these concepts (magnets repel and attract and electricity can create magnets) into explaining the simple electric motor. The simple electric motor consisted of a battery, wire, magnet and block of foam to mount the pieces together.

Above is Travis Pappa demonstrating our chapter's pre-made electric motor

Five of the volunteer chapter members divided into separate tables in the classroom so that each was able to aid 5-7 students in building their motors while the two remaining chapter members present helped where most needed. The two remaining members also served to distribute materials such as extra wire, tape, and wire clippers.

The students shaped the wire loop and the wire "props" that held the loop. Students then inserted the battery, magnet, and wipe loop "props" into their piece of Styrofoam. While this was a straightforward process, the fine-tuning of the motor took time, particularly when it came to shaping the loop. Within 20-30 minutes many of the students had their miniature electric motors running; and some of them were turning so fast that the wire loops were flying off their stands.

While the superconductivity demo was being shown around the room, we further stimulated the students' interest using more hands-on demos, such as real electric motors, and demonstrations of magnetic sand.

For the superconductivity experiment, we were unable to assemble a track due to the superconducting wafer being too thick and heavy; however, we were still able to give demonstration of superconductivity to the class. Our chapter did this by explaining what a superconductor is and by illustrating how a small magnet floats above a superconductor (cooled with liquid nitrogen that had been carefully transported to the classroom).

Supplies and expenses

Item	Price
3 blocks of Styrofoam	$32.59
D Batteries	$38.50
90 2" ceramic magnets:	$56.14
2 1" diameter superconducting disks	$64.00
2 100 ft coated electrical wire	$31.49
Total:	$222.45

Due to an unforeseen increase in price in some of the objects and a decrease in others, our chapter went over by $27.95, however, a generous donor was happy to provide the rest.

Comments from SPS Outreach Volunteers

"My favorite moment was when my group was [done] first and everyone's motor was working. [Meeting] all the kids and seeing how excited they were to have us come in and teach them about magnetism was wonderful. Not to mention how great it was for the club, I think it showed all of us how much of a difference we can make."

"This was important because I know this unique and eye-opening experience at such a young age will impact the students the rest of their lives. I personally felt significant, representing a physicist in front of kids who may want to become scientists one day."

"The most interesting moment [was] when my students completed their electric motors. They had a joyous look on their faces like they had created something truly special, and [they discovered] that science could be very rewarding. [As] time was running out, the students who had completed their motors began to help the others at their table, demonstrating an understanding of the concept!"

"It was incredibly fun to watch the chapter members interact with the students and see so many smiles from [everyone]. It was fun to see how engaged the students were with the demonstrations and particularly the building of the electric motor. While there was a large amount of preparation involved, it is my hope that we can leave the future chapter members with ideas and resources to facilitate easier preparation for future classroom visits."

Conclusion:

The outreach was considered a success as evidenced by how engaged the students were with the lesson. By providing students with a science experience that is not easily forgotten, SPS demonstrated how engaging science can benefit students by allowing them to participate in active, hands-on learning. Furthermore, our chapter designed a format for future elementary school outreaches that our chapter can utilize and improve upon. It is our hope that by doing this, our chapter has made it easier for future outreach teams to engage the community with hands-on science lessons, particularly for electricity and magnetism.

Images from the Event:

From left to right: Brandon Baker (Club Web-designer), Travis Pappa, Amandeep Gill, Jessica Campione (Club Treasurer/Secretary), Jack Horowitz (Club Vice-President), Jude Rowe (Club President), Katie Badham. SPS members introduce themselves and talk about why they love science.

Students try to answer Travis's question of what they know of magnetism.

Students gather around as Jack Horowitz shows students magnetic fields with iron shavings.

Jessica Campion shows students a demo of a magnetic field

After demonstrations each volunteer paired up with a table of 6-7 fourth graders. With Jude (Standing) and Travis (sitting to the right) helping where needed.

Katie Badham distributes supplies to her group of fourth graders.

A student making a coil for the motor.

Brandon Baker asks his group questions about electricity and magnetism in real life.

Students as they react happily to completing their simple electric motors.

Amandeep Gill helps students create their coiled loops of wire.

Jude showing superconducting levitation, as students finished

Katie explaining the safety protocols of liquid nitrogen, as well as simple fun facts.