Science Day in the Mall
SPS at Idaho State University in Pocatello, Idaho
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Dr. Steve Shropshire
Requesting 300 dollars
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Our SPS chapter would like to put together a Science Day at our local mall. The activity will provide the community with demonstrations that exhibit basic principles of electricity, magnetism, and states of matter with the intention of promoting interest in physics among children and the general public. We would like to have this event on Saturday, April 5, 2014.

Our chapter of SPS enjoys being involved with our community and inspiring younger generations to get involved and interested in physics and physics related disciplines. Our chapter has hosted an event like this in the past and it was highly successful. This year we would like to demonstrate electricity and magnetism concepts which would include using a Van de Graaff generator, electromagnets, coils, and other demonstrations. We also would like to demonstrate states of matter by making liquid nitrogen ice cream. Along with the demonstrations we will also have 8.5" x 11" printed displays that will describe what to do and see with each exhibit, and briefly explain the science involved. Samples of what we intend to print for some of the exhibits follow:

Generator

What to do: Move the magnet up and down inside the coil of wire!

What to see: Watch the electric current meter. As you move the magnet, you will create electricity.

Try this: Hold the magnet still, and move the coil instead.

What is going on? Whenever a magnet moves past metal, or whenever metal moves past a magnet, electric charges in the metal are pushed around to make electricity. This is what makes the current meter dial move. This is how we make the electricity that comes from power plants. Falling water or expanding steam flip big loops of wire past magnets to make the electricity we all use at home and school. Moving electric charges are pushed to the side when they move past a magnet. The sideways push on the charges moves them through the wires to make electricity.

Gen-Con

What to do: Hold the handle and turn the crank!

What to see: Try to make the light bulb light! **Don't turn too fast, you can burn out the bulb!**

Try this: Unclip one of the wires and try it. The crank should turn much easier, but the light bulb will not light.

What is going on? When you turn the crank, you flip a coil of wire past a magnet. Whenever metal moves past a magnet, electric charges in the metal are pushed around to make electricity. This is what makes the light bulb turn on. This is how we make the electricity that comes from power plants. Falling water or expanding steam flip big loops of wire past magnets to make the electricity we all use at home and school. It takes work to make the light bulb give off light energy, and that work comes from your effort in turning the crank. When you unclip one of the wires, the electricity can no longer go through the bulb, so you do not have to put in as much energy, and the crank is easier to turn.

Light Bulb Under Water

What to do: Hold down the switch and make the light bulb turn on under water without wires or batteries.

What's going on? The jar with the light bulb is sitting on top of a big coil of wire. When you hold down the switch electricity moves through the big coil. The electricity we get from the wall is "alternating", or "AC" (short for alternating current). This means it changes direction, moving back and forth 60 times every second. Whenever electric charge moves, it creates a magnetic field. All magnetic fields come from moving electric charges. It is the motion of electric charges in atoms that make magnets magnetic. The electricity in this big coil makes a very strong magnetic field. We call this an "electromagnet". Since the electricity changes direction 60 times a second, the magnetic field does too. Changing magnetic fields create electric fields that can make other charges move. This is what makes electricity in the smaller coil of wire inside the jar. This electricity is what makes the light bulb turn on.

Electromagnets

What to do: Flip the switch to send electricity through the wire looped around the metal bolt. You just turned the bolt into a magnet! Try to pick up the nuts, washers, paper clips, and other pieces of metal with the bolt.

What's going on? Wire looped around a bolt makes a magnet when the wire is connected across a battery. If the connection is switched in direction the magnetic field produced by the wire switches direction. The strongest magnets we have are made in this way. Volunteers are challenged to pull apart a powerful electromagnet powered by a single flashlight battery.

Jumping Rings

What to do: Place one of the metal rings over the post on top, then step back and press the red button. Do not look down at the rings, or have any part of your body above the device when you press the button.

What to see: The ring jumps!

What's going on? Electric current through loops of wire around the bottom of the post turns the post into a strong magnet – an electromagnet. Just like with the Gen-Cons and the Simple Generator, the changing magnetic field from electricity in the loops of wire creates electricity in the metal rings, making them magnetic. The magnetism of the rings is opposite to the magnetism of the pole, so they are pushed away. Here, the changing magnetic field is from a changing electric current instead of a moving magnet, which what is happening with the Gen Cons and the Simple Generator.

The following are descriptions of demo activities for which we have yet to design display text for, but should provide enough information on what we intend to present:

Van de Graaff Generator
The Van de Graaff generator can produce voltages (charge separations) of 20,000 volts or more. It separates charge in the same fashion as when you rub a balloon in your hair, or shuffle across a carpet in wool socks, but much faster. A motor spins a big rubber band past metal brushes. The rubber band picks up electrons from the brushes. This makes the top of the generator negative. The base is grounded and held electrically neutral for safety. This allows lots of electrostatic demonstrations with Styrofoam balls with metallic paint, pieces of fur, tart pans, feathers, and pop cans. Volunteers stand on an insulating block and hold onto the generator. They pick up lots of negative charge all over their bodies. Since like charge repels, the volunteer's clothes will "poof" out and their hair will stand on end.

Pocket Galvanometer
Moving charges produce a magnetic field. This is shown by wrapping wires around a compass and connecting the wire across a battery. A current (moving charges) is produced in the wire which in turn produces a magnetic field. All magnetic fields arise from the motion of charges. In a permanent magnet the magnetic field is produced by the motions of electrons in the atoms of the magnet.

Tubular Magnets
Powerful magnets are dropped down a metal tube and a clear plastic tube. The moving magnets create electric currents in the metal tube. These currents produce magnetic fields that oppose the field of the dropped magnets. Because of this the magnets fall very slowly through the metal tube, compared to the clear plastic tube where the magnets fall with hardly any resistance.

Simplest Motor Ever Made
This simple motor is made from a D battery, two paper clips, a small magnet, and a loop of enameled copper wire. Hang the loop of wire from the paper clips below the battery so that electricity flows through the wire. This make the wire loop magnetic, so it is pushed and pulled

by the small magnet attached to the battery. All electric motors have loops of wire that are pushed or pulled around by magnets.

Rolling Magnet on a Copper Plate
Make a ramp with the 3/4" thick copper plate shown at right, a wood box clamped to a table top with c-clamps, and duct tape to keep the bottom of the ramp from slipping. A 30 to 40 degree angle seems to work the best. Roll one of the cylindrical ceramic magnets down the ramp. It will roll very slowly due to interactions with the induced eddy currents.
Roll the magnet at an angle towards one of the sides and it will curve back towards the center of the plate.
You can also have volunteers hold the magnet in their fist while moving it back and forth over the copper to feel the interaction with the induced eddy currents.

Our chapter's members will be volunteering their time on Saturday, April 5, 2014 in the afternoon to present the event. The event will last between 2 to 4 hours, depending on the number of volunteers, and the time of their availability. We will talk to the community about physics and answer any questions they have. Not only is this an opportunity for the chapter to give to the community but it will also be an opportunity to make physics fun and seem less intimidating. Our goal is reach out to everyone in the community, young and old alike. With the Marsh White Award we will be capable of making this possible for our community.

Planned Schedule For Saturday, April 5, 2014
12:00pm-1:00pm Setup
1:00pm-5:00pm Interaction and demos
5:00pm-6:00pm Takedown

Should the number of volunteers be lacking, we will remove a few demos and/or reduce the duration of the event. Which demonstrations we would omit will have to be determined closer to the event when we can get a definite count of SPS members to volunteer. If time is an issue, the event will last from 1:00pm-3:30pm at the shortest, with take down lasting from 3:30pm-4:30pm.

Three 17" x 22" color posters will be printed and posted in the Mall, and approximately 100 8.5" x 11" color posters will be printed and posted in local businesses, schools, and community centers by Friday, March 28. The poster that was used for our 2011 event is attached to provide a sample of what we will display this year. A public service announcement will be sent to local papers, TV and radio stations, and community calendars by Wednesday, March 26. The event will also be advertised on campus, on the ISU event calendar, through ISU email notices to students, faculty, and staff, and on ISU web pages. We will request an appearance of two students on the Pocatello News Channel 6 Morning Show to discuss and advertise the event on either April 3 or 4. Such requests have always been accepted. They like us because we bring cool toys.

The budget below includes the cost for the space rental at our mall, which is for the entire day. Since November of 2013, our local mall has changed management, and after contacting the new management, the price of rental space at the mall has increased from $150 to $200. ISU Physics is willing to make up for the difference and spend $50 towards rental space. We will need milk, sugar, cream, vanilla, a little bit of salt, and some liquid nitrogen to make the ice cream. We will also need bowls, spoons, and napkins to serve the ice cream. Norco of Chubbuck has agreed to donate liquid nitrogen. $110 will be sufficient to get the other supplies from the store. We have requested $40 to help pay printing costs for fliers and posters advertising the event. ISU Physics will cover costs related to printing displays for each demo activity that we set-up, and any additional cost (over the $40 requested) for the printing of advertisements. We will borrow the equipment necessary to carry out the demonstrations from the Department of Physics at ISU.

The proposed budget for Science Day in the Mall is as follows:

- $150 Towards rent space at the mall
- $110 Ice cream making materials, bowls, spoons, etc...
- $40 Printing posters and fliers for advertisements

Total: $300

Expenses beyond $300 up to an additional $100 will be covered by the ISU Dept. of Physics. In the event that more funds are necessary, our chapter is willing to pay for anything else.