The Electrophorus and Static Discharge

Summary

Students will record their observations after creating an electrophorus.

Materials

Styrofoam™ plate
Aluminum pie pan
Styrofoam™ cup
Masking tape
Woolen fabric
Sewing needle
- *Electrophorus Observation*
Sheet
Various materials (plastic, cardboard, cookie sheets, etc.)
Various materials (felt, cotton, animal fur, etc.)
Various materials (tooth picks, paper clips, drinking straws)
Static Starter Kit

Additional Resources

Books

- *Electricity & Magnetism*
, by Dr. John B. Beaver & Don Powers, Ph.D; ISBN 1-58037-222-8
- *Magnets & Electricity*
, by Karen Llee Siepak,; Carson-Dellosa Publishing Co.

Background for Teachers

Electrostatic
refers to electric charges confined to an object and is called "static electricity." Static charges are created by friction between two or more objects or materials and can be generated through various means using friction.

There are several kinds of electrostatic generators, including an electrophorus, which is the simplest to set up and use in a classroom. Rubbing the Styrofoam™ plate with the woolen cloth causes the Styrofoam™ to become charged with electrons (- charge) at the surface. Since Styrofoam™ is an insulator, it cannot transfer its electrons to another material. When the aluminum pie pan is placed on the Styrofoam™, a charge is produced in the pie pan. Since aluminum is a good conductor, the negative charge at the surface of the Styrofoam™ plate causes the electrons in the pie pan to move away from the Styrofoam™ up to the edge of the pie pan. As your finger comes close to the edge of the pie pan as it sits on the Styrofoam™, you will see a charge jump the space between the pie pan and your finger as the electrons are repelled toward Earth, or grounded. When the pie pan is lifted off the Styrofoam™ using the insulating handle (Styrofoam™ cup) and your finger is once again brought near the pie pan edge, a second charge may be seen as the electrons return through the air from your finger to the aluminum pie pan. This can be repeated over and over again without much electrical charge loss from the Styrofoam™ plate. Students may think that materials that lose electrons have lost them permanently. The electrophorus demonstrates how electrons are not lost, but are transferred from one conductor to another.

After students have experimented with the discharge of electrons from and to the pie pan, they are asked to attach a sewing needle to the edge of the pie pan, pointed side out. The needle acts as a lightning rod. Sharp-pointed conductors, such as lightning rods, when attached to a building's highest

point, allow electrons to escape from the building's outer surfaces to the sky, instead of through the building. The needle on the pie pan keeps the pie pan from building up an observable charge.

Intended Learning Outcomes

3. Understand Science Concepts and Principles.

Instructional Procedures

Invitation to Learn

Begin the activity by giving each student a Static Starter Kit (salt and pepper mixed, a plastic spoon and a piece of woolen fabric). Ask the students to carefully dump the salt and pepper mixture onto their desk top. Without mentioning the word "static," give them the challenge to use the other items in the kit to separate the salt from the pepper. They CANNOT touch the salt or the pepper with anything to accomplish this task. (Teacher hint: By quickly rubbing the bowl of the spoon with the woolen fabric and then passing the spoon just above the salt/pepper mixture, the static created will cause the pepper to jump onto the bowl of the spoon.)

Instructional Procedures

- Have students secure the Styrofoam™ plate upside down on their desk with tape.
- Have students tape the Styrofoam™ cup to the inside of the aluminum pie pan making an insulating handle for the pie pan.
- Have students rapidly rub the Styrofoam™ plate with the piece of woolen cloth. Make sure they do not touch the plate with their hand as they are rubbing it. This process may take up to a minute.
- Holding on to the Styrofoam™ cup handle, have students carefully place the aluminum pie pan on the Styrofoam™ plate.
- They are now ready to the follow directions from and make observations on their *Electrophorus Observation* Sheet.
- After completing the first part of the *Electrophorus Observation* Sheet, have students attach a sewing needle to the edge of the aluminum pie pan using masking tape. Make sure that the sharp edge of their needle is pointing out and that it sticks out further than the edge of the pie pan.
- Rub the Styrofoam™ plate with the woolen cloth and repeat the same steps as before. Have your students make observations on the second half of the *Electrophorus Observation* Sheet. Record their conclusions in a science journal or notebook.

Extensions

Curriculum Extensions/Adaptations/Integration

Have other materials available for the students to experiment with in replacing the Styrofoam™ plate. Will other materials allow the experiment to work? Will some work better than the Styrofoam™ plate? Suggestions are several types of plastic, cardboard, metal cookie sheets. The students can also experiment with fabrics that can replace the woolen fabric and also other materials to replace the sewing needle.

Family Connections

- Have the students go on a "Static Scavenger Hunt" at home looking for as many examples as they can find of static electricity.
- Have students go to the gas station and look at the Static Warning signs on gas pumps and then come back to class and discuss it.

Assessment Plan

The *Electrophorus Observation Sheet* will serve as the best assessment tool. The assembly of

the electrophorus and the correctness of the students' observations will help evaluate student performance.

The students may discuss the activity in groups. Group consensus may serve as another way to evaluate student performance.

Bibliography

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Marianne Barnes, & Kathleen Foley (1999). Inquiring into three approaches to hands-on science in elementary and secondary science methods courses. *Ebsco publishing*. Retrieved January 14, 2006, from http://www.unr.edu/homepage/crowther/ejse/barnesfoley.html

All students need to learn scientific skills, such as observation and analysis. Active, student-centered inquiry, in which students learn to apply scientific problem solving, should be at the core of science education. Learning through well-planned activities and experiences promotes cause and effect thinking and the questioning of observed events and resulting data.

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