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Recycling Aluminum Cans in the Lab

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Don't throw away that aluminum can! Don't even place it in the recycling bin. Instead, use it in your next science lab. Aluminum cans may be used to determine how many calories are in a peanut, or to make an electroscope. In addition to the economic advantages of using materials such as aluminum cans, there are also pedagogical advantages: Physical phenomena demonstrated with simple, familiar objects may have a more lasting effect than demonstrations using more sophisticated apparatus (Kruglak 1992).

Static electricity

When two different materials come into close contact—for example, wool rubbing against a balloon—electrons may be transferred from the wool to the balloon. When this happens, the area on the balloon that was in contact with the wool ends up with an excess of electrons and becomes negatively charged, while the wool ends up with a shortage of electrons and becomes more positively charged. This buildup of unequal charges on objects is commonly referred to as *static electricity*.

Materials such as the rubber that balloons are constructed of are called *insulators*. Therefore, it is possible for the majority of the surface area of the balloon to remain neutrally charged while the part that was rubbed by the wool becomes negatively charged.

Protons and neutrons are located in the nuclei of atoms and normally do not move. It is important for students to explain their observations in terms of the electrons moving from one object to the next and what the end results are. If an object that has acquired a charge, such as the balloon described above, is moved close to a neutral object, such as a Styrofoam ball, the ball will become positively charged by *induction*. This can be explained by the big rule in electricity and magnetism—likes repel while opposites attract.

The electrophorus lab (see page 71) demonstrates these concepts by allowing students to see static electricity in action. A pie pan serves as the charged object that induces a charge in a soda can simply by being moved near the bottom of the can (induction). If the charged pie pan touches the soda can, the electrons actually flow into the soda can, charging it by *conduction*. Instruct students to explain their observations in terms of which direction the electrons move, and whether the observed reaction was caused by induction or conduction.

Soda-can electroscope and electrophorus lab (Kruglak 1992)

Note: Static-electricity activities will be most successful and exciting on days when there is low relative humidity. When there is a large amount of moisture in the air, some of it forms a coating on the surfaces of objects. This surface coating of moisture can neutralize a buildup of static charge.

Materials (per group of four students)

- aluminum soda can
- Styrofoam coffee cup
- Styrofoam insulation board or other Styrofoam products, such as picnic plates
- disposable aluminum pie pan
- wool, fur, or other cloth
- 1 cm x 10 cm aluminum foil
- masking tape
- balloons or drinking straws (optional)

Procedure (Soda-can electroscope) (See inset photograph of an assembled soda-can electroscope and electrophorus apparatus.)

1. Carefully bend the tab-top on the aluminum can so that it sticks straight out from the end of the can. (Safety note: Watch for sharp edges on the can.)
2. Set the Styrofoam cup upside down and tape the soda can horizontally on top of the cup.
3. Roll a 0.5 cm x 3 cm strip of aluminum foil around a drinking straw to form a hook on one end of the strip, and hang the hook over the end of the pull tab.
4. Use your electrophorus apparatus (see instructions below) to charge the electroscope.
5. When the charged object is brought near the can, the foil leaves should repel each other. In addition to the pie-plate electrophorus apparatus, other charged objects could include balloons or vinyl strips such as a drinking straw.

Procedure (electrophorus apparatus)

1. Cut a 30 cm square of Styrofoam insulation for the base or use a Styrofoam picnic plate placed upside down.
2. Fasten an insulating handle to an aluminum pie pan by taping a Styrofoam cup in the center of the pan.
3. To use the electrophorus, rub the top surface of the foam base or

plate with fur or cloth to charge it. Then set the pan on top of the foam, touch the pie pan with your finger (this positively charges the top of the pan), remove your finger, and then lift the pan by the handle.

4. Bring the positively charged pie pan into contact (conduction) with the bottom end of your soda-can electroscope.
5. Repeat the above action, but do not touch the pie pan to the can (induction).

Conclusion

Many other demonstrations and experiments can be performed using aluminum cans and other recycled materials. For example, aluminum cans can be used to demonstrate pressure. Students can predict what will happen when a small amount of water is heated to boiling inside a can and the can is quickly inverted in cold water (the can implodes). If the can is not inverted in water, nothing happens. Students can predict whether a diet or regular soda will sink or float (the diet soda will float). Of course, soda cans aren't the only familiar objects that teachers and students can use for science activities. Eggs can be used to demonstrate inertia (a raw egg will continue to spin after being lightly touched). Cornstarch and water can produce "oobleck", a non-Newtonian type of matter. Straws can be used as musical instruments to illustrate the physics of sound. Milk containers can be used as terrariums. Another benefit of such activities is that by using ordinary household items and proper safety precautions, students can demonstrate and explain the same experiments at home that they did at school, which reinforces learning.

These activities can also be used as discrepant events to introduce topics and help to dispel misconceptions. For example, Bernoulli's principle can be demonstrated by blowing across a sheet of paper, a pencil in a glass of water appears bent due to refraction, and food coloring appears to move faster through hot water than in cold water due to convection.

Most school budgets are inadequate for science teaching materials. Teachers can find many recycled materials at yard sales to use in the science classroom. They can prepare lists of items that students and parents can collect throughout the year for use in their classrooms.

Figure 2. Questions for static electricity lab worksheet.

1. Charge a straw by rubbing it on a piece of cloth or through your hair. Position the straw near the foil strips attached on the end of the soda can. Describe what you observe and give an explanation.
2. Bring a positively charged pie plate into contact (conduction) with the bottom end of the can. Describe what you observe and give an explanation.
3. Repeat the above action, but do not touch the pie pan to the can (induction). What happened and why?
4. Using the electrophorus device, charge the pie pan negatively. Explain your observations.

5. Charge the pie pan positively. Explain your observations.

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References

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