Post-Show

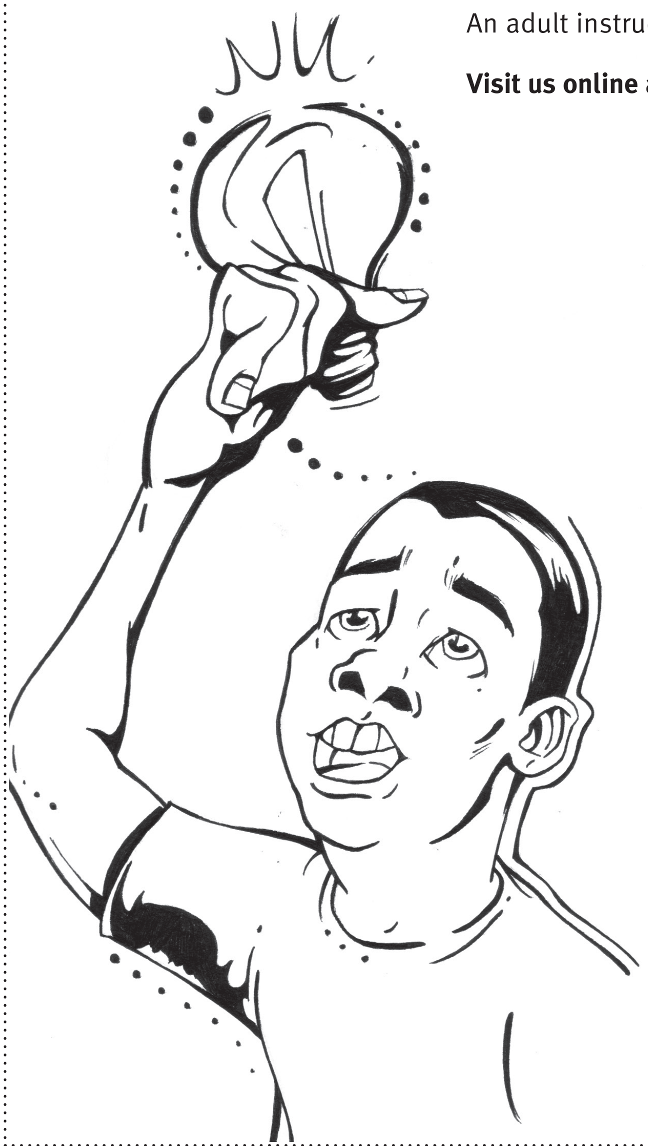
ELECTRICITY

After the Show

We recently presented an electricity show at your school, and thought you and your students might like to continue investigating this topic. The following activities are designed to review and extend the ideas covered in the show.

Please remember to use appropriate safety measures for all activities. Experiment area should be dry. Use only the electrical source indicated in the equipment list. An adult instructor should always supervise students during experiments.

Visit us online at www.fi.edu/TSS or contact us at tss@fi.edu.



STATIC DETECTIVE

FOR GRADES 1-4

During the show, we learned that "like charges repel." An electroscope uses this principle to indicate if a static electric charge is present. In this activity, students will build a simple electroscope. Note: It will work best on cool, dry days.

EQUIPMENT

Sturdy copper wire or straightened paper clip
Glass jar
Cork to fit in neck of jar
Aluminum foil

PROCEDURE

1. Carefully put the wire through the center of the cork, so that there are a few inches of wire above the cork and a few inches below the cork. (An adult may need to do this part for younger children.)

2. Bend the bottom part of the wire so that there is a small hook or "L" shape.

3. Cut a 3-inch by ¼-inch piece of aluminum foil. Fold it in half width-wise.

4. Drape the fold of the foil over the wire so that a foil wing hangs down either side.

5. Fit the cork firmly in the neck of the jar.

6. Your electroscope is complete! To use it, charge an object with static electricity, and then lightly touch it to the wire sticking out of the top of the cork. What happens to the foil wings? Now observe what happens if you touch a finger to the wire. Why does it do that?

WHY?

When you bring your charged object near the wire, the charges start to flow down the wire. (This is one way to see that static electricity isn't really much different from current electricity.) When the charges get to the foil, equal amounts of the same kind of charge flow onto each wing. Since both wings now have the same kind of charge, they repel (push away from) each other. Touching your finger to the wire draws the charge up into your finger; since the wings are no longer charged, they fall together. What other objects can you use to create static electricity?

DIMMING DEVICE

FOR GRADES 3-6

In the Electricity show, we saw how current travels through a light bulb. Have you ever wondered how the light dimmers in your house work? They use a device called a rheostat to control how much current reaches the bulb. In this activity, students make and test a simple rheostat. Make sure the experiment area is dry, and use only the electricity sources indicated in these directions.

EQUIPMENT

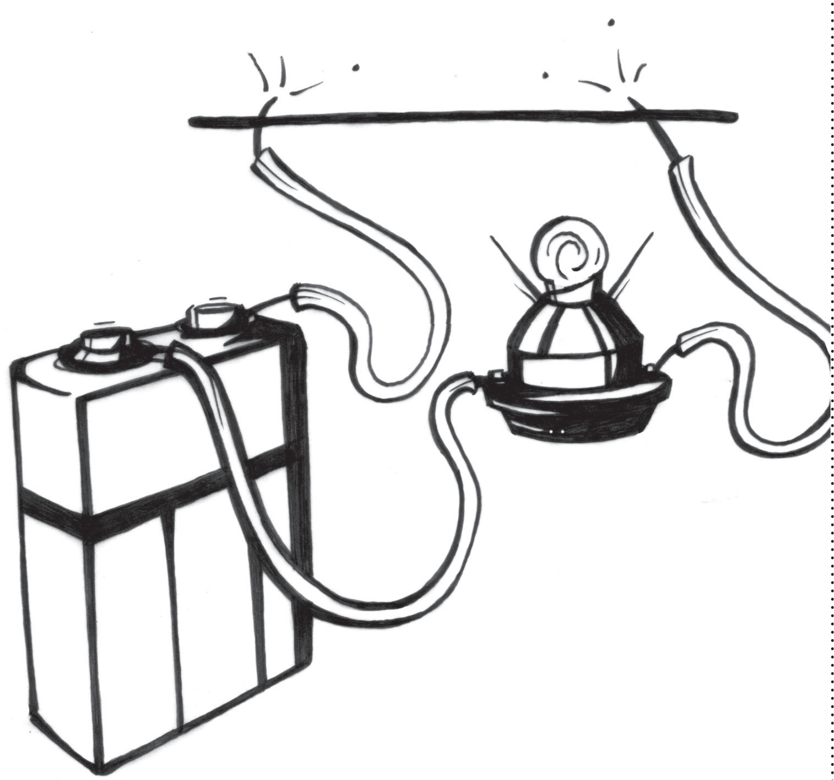
1 foot of insulated, single-strand, thin copper wire
Wire strippers
9V battery
Replacement graphite for an automatic pencil
Small light bulb (works best if sitting in demonstration socket)

PROCEDURE

1. Cut the wire into three pieces, about 4 inches each. Strip about ½ inch of the insulation off each end of each piece.
2. Connect one wire to one electrode of the battery and to the replacement graphite. Connect another wire to the other end of the graphite and the bulb. Connect the last wire to the bulb and the other electrode of the battery.
3. Hold onto the insulated portion of the wire that connects the bulb to the graphite. Gently slide the wire back and forth along the graphite. What do you notice? Is there a point at which the light will not glow at all? How can you get maximum brightness?

WHY?

First you must arrange the battery, wire, and bulb in a circuit (a closed path) for the current to flow through. However, the graphite in a pencil is a poor electrical conductor. Some of the electrical energy that tries to flow through the graphite gets lost as heat, so the bulb's brightness is reduced. The longer the distance it tries to flow through the graphite, the more energy gets lost. What other materials could you use instead of graphite?



MAKE YOUR OWN BATTERY

FOR GRADES 5-8

As we learned during the Electricity show, batteries convert stored chemical energy into electrical energy, thus providing the power to start a current flowing through a circuit. In this activity, students will construct a simple battery. This battery will not be able to run a motor or energize most light bulbs, but it will produce a dim glow from an LED. Make sure the experiment area is dry, and use only the electricity sources indicated in these directions.

EQUIPMENT

Knife

Lemon
(a large, fresh, juicy lemon works best)

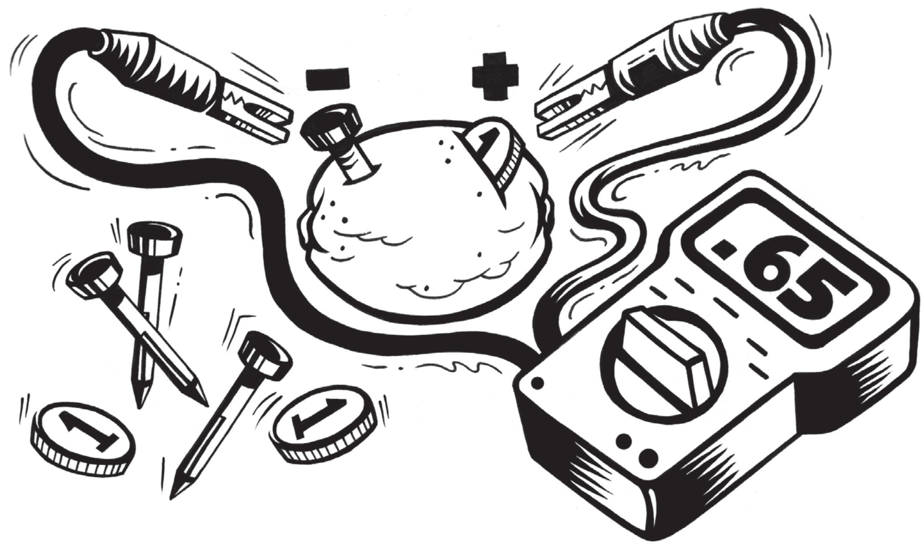
2” galvanized nail
(galvanized nails are coated in zinc)

Penny
must be a pre-1982 copper penny)

Volt meter

Connecting wires

Light-Emitting Diode
(available from stores such as Radio Shack)



PROCEDURE

1. Make a slit on one side of the lemon. Insert a penny so that one edge sticks out.

2. Push a galvanized nail into the other side of the lemon. The penny and the nail should *not* touch.

3. Connect the volt meter to the penny and nail to read the voltage of the lemon battery.

4. Connect multiple lemon batteries from “+” (penny) to “-” (galvanized nail) to increase the total voltage.

5. Complete an electric circuit by connecting the lemon batteries to an LED.

WHY?

A battery consists of two electrodes, each of which houses a chemical reaction. In one electrode, a chemical gives up electrons; in the other, a different chemical accepts electrons. As this pair of reactions takes place, the chemical energy that is released forces the electrons through a circuit. Electrons flowing through a circuit creates current, the source of electrical energy.

In this battery, the zinc nail and copper penny form the electrodes. Electrons will flow from the “-” electrode of a battery, through a metal conductor, toward the “+” electrode of the battery. The lemon juice is an electrolyte, which also helps the electrons flow. A single cell lemon battery will not produce enough current to light a bulb. To solve this problem, connect multiple lemon batteries in a circuit. Now try experimenting with different conductors, or different configurations of the circuit!

MORE INFORMATION...

We've provided the following information to help refresh your memory about the topics we covered during the show, and to deepen your understanding about important electricity concepts.

Current Electricity: For most modern electronic devices, we use current electricity. A stream of electrons flows through wires, just like current flows in a river. Current will only flow in a complete circuit.

Circuits: Current electricity needs a complete circuit, or path, back to its source. If current can't get back to the battery, nothing happens. This is the principle behind fuses and circuit breakers: If there is an overload (too much electricity), then these will break the circuit and prevent electricity from getting back to its source.

Conductor: A material that allows current to flow easily. Metals are strong electrical conductors; wood, plastic, and other materials that do not conduct well are called insulators. Water is also a strong conductor – and since our bodies are mostly water, that makes humans good electrical conductors!

The First Use of Current Electricity: Believe it or not, living things were using current electricity long before the battery was invented. Any organism with a nervous system uses current electricity to send information through that system. This electricity, like the electricity in the battery, is direct current (or DC) and is produced through chemical reactions.

Volta's Battery: The first manmade source of current electricity was the battery, which was invented by Alesandro Volta. The battery uses a chemical reaction to pull electrons off the metals inside. This electron build-up generates current. There is some debate on whether the electrons are pushed from the negative end of the battery or pulled by the positive end of the battery; it may be a little of both. The first battery was actually a Voltaic pile, which is similar to the lemon battery featured in this packet. This kind of electricity is called direct current, or DC, because the electricity flows in only one direction.

Galvanometer: The galvanometer, the first device to measure electricity, was invented in 1880. The device was named after Luigi Galvani, who first theorized that muscles are controlled by electrical impulses. A galvanometer only measures small amounts of electricity, but the voltmeter measures larger amounts of electricity.

Alternating Current: Alternating current, or AC, is the kind of electricity that we get from a wall outlet. Michael Faraday discovered how to make this kind of electricity. He realized that electricity and magnetism were very closely related, and figured that if a magnet could be made using electricity and a coil of wire, then perhaps electricity could be made using a magnet and a coil of wire. His idea is used everyday at power plants to make electricity for millions of people. Alternating current gets its name from the fact that electricity reverses direction very swiftly – about 60 times per second!

Edison's Light Bulb: Thomas Edison is responsible for the first practical light bulb. His design consists of a filament, some wire, and a glass bulb. A vacuum pump is used to remove all oxygen from the bulb, to prevent the filament from burning. When an electric current is passed through the filament, it gets very hot and starts to glow. This is called incandescent light. Although Edison received fame and fortune, the idea for the incandescent light actually came from J.W. Star. Edison used Star's idea and, with the help of a few friends, tested over 6,200 materials until he was able to get a light that would glow continuously for 48 hours.

Tesla's Fluorescent Light Bulb: Nikola Tesla's primary invention is the Tesla coil, a modified version of which we used in the show. The Tesla coil makes high-frequency electricity, which can travel a short distance through the air and will not electrocute people. He invented the fluorescent light tube primarily to demonstrate the effects of the Tesla coil, and did not attempt to patent or market it. Edison picked up his idea and got the patent for it. Tesla is now credited with developing the entire electrical generation and distribution system that we use today.

Oersted's Electromagnet: In 1820 Hans Oersted discovered that when a wire with electric current flowing through it is held near a compass needle, the needle is deflected. This was the first realization that electricity and magnetism were related. Five years later, William Sturgen discovered that placing an iron core in a coil of wire would make a stronger deflection. In the late 1820's, Joseph Henry developed the first practical electromagnet.

Van de Graaff Generator: The Van de Graaff generator is simply a device for making large amounts of static electricity. It uses a motor to rub a rubber belt over a small metal comb, which pulls negative charges away. The large metal dome collects these charges. The charges can also be spread to anything (or anyone) touching the metal dome. When someone touches the dome, charge travels onto the person and his or her hair. Since the hairs are all covered with like charges, they repel each other, which makes the person's hair stick up.

Lightning: This short-lived, bright flash of light is produced by a 100 million-volt static electrical discharge. However, we can't actually see electricity. What we see as lightning is the glow of super-heated air surrounding the path of the electricity. In fact, lightning heats the air through which it travels to 50,000° F!

MORE RESOURCES...

The Franklin Institute: On your next field trip, visit Electricity, an interactive exhibit all about electromagnetic phenomena. You can build a circuit, power a city, and even get shocked! Go to http://www.fi.edu/teacherresources/ for a guide to the exhibit.

Magnetism and Electricity: Visit http://www.fi.edu/msp/magnetism/index.html for a collection of relevant teaching resources. You'll find lesson plans, games, videos, and more!