Electricity Field Trip Workshop Teacher Packet

GRADE LEVELS:
Grades 4th – 6th

OBJECTIVES:
Participants will learn how electricity is produced and create a simple electromagnet.

ACADEMIC CONTENT STANDARDS:
- Physical Science: Grades 3rd – 5th E: Trace how electrical energy flows through a simple electrical circuit and describe how the electrical energy can produce thermal energy, light, sound and magnetic forces.
    - 5.3: Describe that electrical current in a circuit can produce thermal energy, light, sound and/or magnetic forces.
    - 5.4: Trace how electrical current travels by creating a simple electric circuit that will light a bulb.
- Scientific Inquiry: Grades 3rd – 5th C: Develop, design and safely conduct scientific investigations and communicate the results.
    - 4.4: Explain the importance of keeping conditions the same in an experiment.
    - 4.5: Describe how comparisons may not be fair when some conditions are not kept the same between experiments.
    - 5.4: Identify one or two variables in a simple experiment.
    - 5.6: Explain why results of an experiment are sometimes different (e.g., because of unexpected differences in what is being investigated, unrealized differences in the methods used or in the circumstances in which the investigation was carried out, and because of errors in observations).
- Scientific Inquiry: Grades 6th – 8th B: Analyze and interpret data from scientific investigations using appropriate mathematical skills in order to draw valid conclusions.
    - 6.4: Explain that a single example can never prove that something is always correct, but sometimes a single example can disprove something.

VOCABULARY WORDS:
Circuit - individual electronic components through which electric current can flow.
Conductor - a material allowing the flow of electric current.
Electromagnet - a magnet whose magnetic field is produced by the flow of electric current.
Generator - a device that converts mechanical energy to electrical energy.
Insulator - a substance that resists the flow of electric current.
Load - a well-defined output terminal in a circuit.

EXTENSIONS AT COSI:
Gadgets Exhibition Area
- Find some examples of how energy is created using magnets, and how energy can be conserved with different types of energy saving devices.

Progress Exhibition Area

- Discover how electricity has changed our lives from 1898 to 1964. Can you think of how this new technology might have created a sense of hope or fear at those times in history?

ADITIONAL RESOURCES:

http://school.discoveryeducation.com/curriculumcenter/electricity/projectideas.html
http://www.nsf.gov/news/classroom/physics.jsp
http://www.msichicago.org/education/educator-resources/classroom-activities/educator-info/activities/build-an-electric-motor/
http://www.physicscentral.com/experiment/askaphysicist/physics-answer.cfm?uid=20101026032559

SAMPLE TEST QUESTIONS:

1. A copper wire with a plastic coating is placed near a compass. When both ends of the wire are connected to a battery, the compass needle moves. Why does the compass needle move?
   A. Electricity flows from the wire to the compass.
   B. Magnetic force flows from the battery to the wire.
   C. Thermal energy flows through the wire to the compass.
   D. Electricity flows through the wire, producing magnetic force.

2. Which of the following is not produced directly from an electrical current?
   A. Sound
   B. A magnet
   C. Heat
   D. Smell

3. Draw a complete electrical circuit to light a light bulb in the space below.

Electricity Pre Visit Activities

Bulbs and Batteries

Primary Audience: 4th – 8th grade

Description: This activity will teach the basics of creating an electrical circuit.

Key words:

- circuit
- electricity
- energy

Concepts:

To succesfully light a light bulb students must create a closed circuit with a power source, wires and a light bulb.

Materials:

- 2- 12" 22 gauge insulated wires with the tips stripped to expose the copper
- 1 D-cell battery
- 1.5 volt light bulb (flashlight bulb)

Instructions:

Give each student or group of students the supplies and allow them to experiement until they are successful in lighting the bulb.

What's Going On?

Attaching one wire to one end of the battery and the metal part of the bulb base, and then attaching the other wire to the other end of the battery and the bulb base creates a closed circuit. This is an introduction to more complex concepts with electricity. A bulb base, switches, conductors, and insulators can be added to make this activity more challenging.

Relevant Ohio Science Content Standards:

- Physical Sciences: 5.3, 5.4

Electricity Post Visit Activities

Jumping Beans

Primary Audience: 6th – 8th Grades

Description:

This experiment will examine the properties of static electricity.

Keywords:

- Static electricity
- Friction

Concepts:

Static electricity is a simple form of electric energy and can be created using friction.

Materials:

- Three soybeans
- One 11 inch clear balloon

Instructions:

1. Place three soybeans into the balloon.
2. Blow up the balloon, but not all the way, and tie it.
3. Rub the balloon with the beans inside back and forth against your pants leg or your hair for about 20 seconds.
4. After the allotted time, stop moving the balloon and let the soybeans settle. How do the beans move? How do they settle? Do they come close together or push each other apart?
5. Once the beans have stopped moving, try passing your hand close under the beans, but not touching the balloon. What happens?

What's Going On?

Rubbing the balloon generates static electricity. Static electricity is when friction separates the positive and negative charges that make up all matter. These charges build up on the beans. Similar charges repel each other and opposite charges attract. Which type of charges, similar or opposite, build up on the beans based on your observation?

Relevant Ohio Science Content Standards:

- Physical Science: 7.3

Static Spoons

Primary Audience: All Ages

Description:
Explore how a mixture of salt and pepper can be separated using plastic spoons.

Keywords:
- Positive charges
- Negative charges
- Ionic bonds

Concepts:
Electrons hold negative charges while protons hold positive charges.

Materials:
- Plastic spoons
- 1/2 cup salt
- 1/2 cup black pepper
- Bowl
- Paper plates or trays

Instructions:
Don't tell the students the name of this activity at first. Mix a bowl of salt and pepper together. Explain that a mixture consists of substances that can be physically separated again. Ask the students, "Using only the plastic spoons, how can we separate the two seasonings?" Encourage students to think creatively and brainstorm a variety of ways to separate the pepper and salt.

Give each student one plastic spoon and a spoonful of the salt and pepper mixture on a paper plate. Students may work individually or in small groups. Challenge them to invent a technique to separate the pepper using their spoon. They may experiment with one or more methods.

Have students share their ideas for separating the seasonings with the entire class. Guide class discussion so that students consider the advantages and disadvantages of the separating techniques. If a student suggests using static electricity to separate the pepper from the salt, use this as an opportunity to introduce this concept. (If no student suggests using static electricity to separate the seasonings, give them a hint – the title of this activity is "Static Spoons.") Ask students what they know about static electricity and how it might be useful in separating the salt and pepper.

Encourage students to experiment with ways to statically charge their spoons and pick up the pepper out of the seasoning mixture. (They will discover that rubbing the spoon on their hair, wool, or polyester fabrics works well.) Ask them to describe their observations and propose ideas to explain why pepper is attracted to the spoon, but salt isn't.

What's Going On?

When two different materials rub together electrons can be exchanged between them. A plastic spoon can be statically charged, gaining electrons and making it negatively charged. It will then attract positively charged particles, or the positive charges on neutral substances (such as the flecks of pepper). The statically charged spoon does not affect salt because the salt is slightly heavier than the flecks of pepper; however, if you move the spoon closer or acquire a much higher charge of static electricity you can pick up the salt.

Evaluate:

Observe students during their experimentation with statically charged spoons as they ask questions, test ideas, and build understanding to explain how pepper is attracted to a statically charged spoon. Have students generate questions for further investigation, such as "What other materials might static forces move?" Try placing the charged spoon near a steady trickle of water (i.e. a thin, slow stream). Is the charge strong enough to affect the flow of water? (If the stream is too strong, the effect will be difficult to see.) Ask students to think about real-world situations in which an understanding of static electricity might be useful. Suggest they research how static electricity is utilized in copier machines.

Relevant Ohio Science Content Standards:

- Physical Science: 4.3, 9.2, 9.5