Electricity in Progress

GRADE LEVELS:
Grades 4th - 8th

CONCEPT:

- Explore the history of electricity through two 15 minutes shows, a 30 minute hands on exploration and a 30 experience in the Progress exhibition

OBJECTIVES: Participants will be able to:

- Learn the important history makers in the field of Electricity
- Learn how electromagnetism is used to create electricity for our homes
- Understand how microwaves work.

ACADEMIC CONTENT STANDARDS:

- Science: Science and Technology: 4.1, 4.2, 6.1, 7.1, 8.1
- Science: Physical Science: 5.3, 5.4

VOCABULARY WORDS:
Conductor- A material through which electric current can pass
Current- A flow of electric charges
Alternating Current- A flow of electric charges that is constantly switching directions
Voltage- The amount of energy an electric charge has
Induction- The creation of current by moving a magnet, and the creation of a magnet by flowing current.

PEOPLE:
Michael Faraday- (1791-1867) Discovered electromagnetic induction, the principle that allows motors and generators to work.
James Clerk Maxwell- (1831-1879) Demonstrated that electricity, magnetism, and light are all actually the same phenomenon, unifying those ideas as electromagnetism.
Nikola Tesla- (1856-1943) Contributed to the beginning of commercial electricity. His work and patents form the basis of modern AC electrical power systems.
Percy Spencer- (1894-1970)
Helped improve magnetron technology, and his melted chocolate bar led to the development of the microwave oven.
Philo T Farnsworth- (1906-1971) Developed the first fully-functional and all-electronic television system at just 21 years old.

EXTENSIONS AT COSI:

- Progress
- WOSU
- The electromagnetic exhibits in Gadgets

ADDITIONAL RESOURCES:

- "There Are No Electrons" (book) by Kenn Amdahl
- "Death Ray Chocolate: the twisted history of the microwave oven" (article) by Steve Whitt http://www.yesmag.ca/microwave/

SAMPLE TEST QUESTIONS:

1. In the space below, trace or explain a simple circuit to light a light bulb that includes a power source and a light bulb.

2. An electrical current in a circuit can produce:
   a. Light
   b. Sound
   c. Heat
   d. All of the above.

3. A kilowatt measures:
   a. power
   b. light
   c. Carbohydrates
   d. Fat

Electricity in Progress Pre Visit Activities

Jumping Beans

Objective: This experiment will examine the properties of static electricity.

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. Blow up the balloon, but not all the way, and tie it.

2. Rub the balloon, with the bean inside, back and forth against your pants leg or your hair for about 20 seconds.

3. 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? 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. Friction can separate positive and negative charges that make up all matter. This is static electricity. 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?

Ohio Science Content Standards:
Physical Science: 7.3

Magnet Races

Description: Race magnets through a simple course using only linear induction.

Keywords: Linear Induction

Concepts:

- A moving magnetic field creates a flow of current. Magnetic repulsion is caused by two magnetic fields. This is called linear induction.

Materials:

- Per Group:
  - Masking Tape
  - Bar Magnets
  - Stopwatch
  - Race Track

Instructions:

1. What is a magnet? Can anyone tell me? Take answers from kids. Summarize their comments. So if I put this magnet near something metal it will stick to it, right? Try it.

2. What if I put two magnets near each other – what will happen? Does anyone have a prediction? Take answers from kids. Let's try it. *(Place two magnets together so that they attract one another.)*

3. Now, what if I turn one magnet so that the other end is facing this magnet. Does anyone have a prediction? Try it. (Summarize what happens when two magnets are near one another. The opposite ends attract and the same ends repel.)

4. Do you think we could use that push to move one magnet around this racetrack without touching it? *(Let each person take a turn.)*

Possible Interactive Questions:

- What made the magnets move?
- Which individuals had faster times while navigating the course? Why? What actions did they take to improve their times?

What's Going On?

Magnetism, like gravity, is a force that cannot be seen. Every magnet, however, has an area in which it exerts its force. This area or space is called the magnetic force field. The size of this field depends upon the strength and size of the magnet. All parts of a magnet do not show equal strength. The areas of greatest strength or attraction on a magnet are called the poles. If you suspend a bar magnet horizontally by a loop of thread, you will find that when the magnet stops swinging, one end will point north. This end is the north-seeking pole, or simply North Pole. The other end is the south seeking, or South Pole. Magnets are usually marked with an N for North Pole and an S for South Pole. If you place similar poles together (N-N or S-S), the magnets will repel each other. If you place opposite poles together (N-S), the magnets will attract and stick to each other.

If two magnets are brought close enough together, their fields will begin to interact in the following ways:

- If the magnets' north poles are brought together, the magnets will repel one another (like poles repel).
- If the north pole of one magnet is brought to the south pole of the other magnet, the magnets will attract one another (opposite poles attract).

Further Exploration:

1. Try using a variety of devices to transport your magnet. For example, place a magnet inside a matchbox car and attempt to negotiate the track again. Did it improve you time? What if you tried different magnets?

Ohio Science Content Standards:

- Physical Sciences 1.5, 3.3

Electricity in Progress Post Visit Activities

Static Spoons

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:

1. For this activity, don't tell the students the name of the 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 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.

2. 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.

3. 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.

4. Encourage students to experiment with ways to statically charge their spoon 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, 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 has an extremely stable molecular structure held together with strong ionic bonds. Such bonds easily dissipate static forces because they get rid of the excess static charge quickly. In the case of the spoons, the negative charge is removed.

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.

Ohio Science Content Standards:
Physical Science: 4.3, 9.2, 9.5

Make Your Own Compass

Description: Make a working compass.

Keywords: Compass, Magnet, Poles

Materials:

- 2 sewing needles (needles are sharp objects, so take appropriate precautions)
- 2 small flat pieces of foam from a foam food tray
- 2 wide plastic or glass bowls
- 1 bar or refrigerator magnet (the kind used with the alphabet letters works best)

Instructions:

1. Fill both bowls about half-full with water. Place them on a flat surface such as a table.
2. Float a piece of foam on the water. Carefully lay one of the needles on top of the foam. (see illustration). Does the needle point in a certain direction? What happens when you push the needle in another direction?
3. Take the remaining needle and carefully rub it on the magnet in one direction for about 60 strokes. **Do not rub the needle back and forth across the magnet - it will not work!**
4. Now lay the remaining piece of foam on the water in the second bowl, and lay the other needle on the foam. Does this needle point in the same direction as the first needle? What happens if you try to make the needle point in another direction?

What's Going On?

The earth produces a magnetic field. This field, although weak, is sufficient to align other magnetic field within it. Magnets produce a magnetic field. By rubbing a magnet along the needle, a magnetic field is formed within the needle. By floating the needle on the foam, you let it rotate freely so it can orient itself within the earth's magnetic field, to point toward the north or south magnetic poles of the planet.

Compasses and their natural world counterpart, loadstones, have fascinated people since their discovery thousands of years ago. Einstein was given a compass when he was a young boy. The needle's swing impressed him and convinced him that there had to be "something behind things, something deeply hidden."