Lesson 9: Products of Electricity

Getting Started

Big Ideas

✓ What does electrical power produce?
✓ How is electrical power produced?

Facts and Definitions

✓ Electricity can produce light, heat, and sound.
✓ An electromagnet is an object that acts like a magnet, but its magnetic force is created and controlled by electricity.
✓ An object with an electrical current also has a magnetic field.

Skills

✓ Observe and investigate the ability of electric circuits to produce light, heat, sound, and magnetic effects. (S)
✓ Explain how magnetism is related to electricity. (S)
✓ Explain and observe how electricity can be used to generate magnetism. (S)
✓ Describe and explain the parts of a light bulb. (S)

Materials

"Light, Heat, and Sound"
"Creating an Electromagnet"
"Swinging Cereal"
"Parts of a Light Bulb"
"The Invention of the Light Bulb Mini Book (Page 1)"
"The Invention of the Light Bulb Mini Book (Page 2)"
✓ Electricity and Magnetism by Adamczyk and Law
✓ 3-foot long copper wire (kit)
✓ D cell battery (kit)
✓ electric wire clamps
✓ home magazines and catalogs* (Activity 1 - Option 2)
✓ light bulb and holder
✓ nail
✓ O-shaped cereal pieces
✓ paper clips (kit)
✓ plastic comb or balloon (kit)
✓ scissors
✓ stapler
✓ tape or glue* (Activity 1 - Option 1)
✓ thread (kit)

Introduction

Ask your child to explain what he learned about electricity in yesterday’s lesson. Tell him that today he will explore what electricity produces and will look at different types of electrical energy.

Activities

Activity 1: Light, Heat, and Sound

Electricity can produce energy, and energy can do work. Energy can do work for us and make our lives easier. Discuss that electrical energy can produce light, heat, and sound. Select one of the following options.
Option 1
Let your child look at the electrical devices on the page, "Light, Heat, and Sound," and group them according to whether they produce light, heat, or sound. He can draw them or write their names. After he has grouped the items, ask him to see how many additional items he can add to each group.

Answers
Sound: doorbell, alarm clock, keyboard
Heat: space heater, microwave, hairdryer, oven
Light: flashlight, light bulb, headlight

Option 2
Ask your child to get three sheets of paper and title them "Light," "Heat," and "Sound." Give him a variety of home magazines and catalogs. Ask him to find pictures of electrical devices that produce light, heat, and sound. He can cut them out and glue them on the sheets, creating a collage for each category.

Reading and Questions
Ask your child to read pages 20-23 of the book Electricity and Magnetism before answering the following questions about electromagnetism.

1. How did the Danish scientist Hans Christian Oersted discover that electricity and magnetism were linked?
   - He noticed that when current went through a wire, it caused a compass needle to change direction.

2. What is a solenoid?
   - When current flows through a coiled wire, it behaves like a bar magnet. This is called a solenoid.

3. Describe how to make an electromagnet.
   - Coil a wire very tightly around a piece of magnetic material (such as an iron nail). Connect each end of this coil to a battery. The electricity going through the solenoid turns the nail into an electromagnet.

Activity 2: Electromagnetism
Tell your child that magnetism is another product of electricity. Explain that an electromagnet is an object that acts like a magnet, but its magnetic force is created and controlled by electricity.

Review the fact that electricity passes through wires. A wire with a current passing through it experiences a magnetic field. This magnetic field is not like the one you see in a normal magnet; instead, it is a circular field. If you remove the current from the wire, the field disappears.

Ask your child to follow the directions on the page called "Creating an Electromagnet." Provide assistance as needed. When your child has finished the investigation, discuss the link between electricity and magnetism.

Note: You only need to strip the coating from a small section on each end of the wire so it can be connected to the battery. You do not need to strip the whole wire. The magnetic field created by coiling the wire will exist whether the wire is coated or not.

Reading and Questions
Remind your child that an electrical charge is produced when electrons move from one atom to another. Static electricity is what we call it when an object (or person) has a bunch of extra electrons trapped on them. This gives the object a negative charge. Those extra electrons are always looking for positive charges, however, and if a lot of them find that positive charge at the same time, you may see a static charge as all the electrons rush to the positive charge. You can feel this charge as a small shock. When it is dark enough, you may see this static charge as a small spark as well.

Ask your child to read pages 6-9 in Electricity and Magnetism and then answer the questions below.
1. Why does static electricity work better when the weather is cold and dry?
   - When it is wet or damp, the static is discharged into the air and does not build up.

2. Explain how static electricity works.
   - All materials are made of negative and positive charges. Opposite charges attract one another and usually stay balanced. Sometimes, extra negative charges build up on the surface of an object. When they find a way to escape, a static charge is produced.

3. What are the 3 parts of an atom and their charges?
   - proton - positive charge, electron - negative charge, neutron - no charge

4. What is one of the most powerful examples of static electricity on earth?
   - lightning

5. Why can't lightning be used as a source of power?
   - No one knows where lightning will strike.

**Activity 3: An Experiment in Static Electricity**

Review the fact that atoms usually have the same number of electrons and protons. When this is the case, the atom has no charge — it is neutral. But if you rub objects together, electrons can move from one atom to another. Some atoms get extra electrons, so they will now have a negative charge. Some atoms lose electrons, so they will now have a positive charge. When charges are separated like this, it is called static electricity. If two things have different charges, they attract, or pull towards each other. If two things have the same charge, they repel, or push away from each other.

Tell your child that this explains why his hair stands up when he takes off his winter hat. The hat rubs against his hair, and electrons move from his hair to his hat. So his hair gets a positive charge. Now each of his hairs has a positive charge, and since each has the same charge, they try to repel one another. The hairs stand up to get as far away from one another as possible.

Now let your child experiment with static electricity by conducting the investigation described on the page, "Swinging Cereal."

When your child finishes the experiment, ask him what happened. Discuss the fact that when he combed his hair or rubbed the balloon on his hair, he moved electrons from his hair to the comb/balloon. The comb/balloon then had a negative static charge. The neutral cereal was attracted to it. When they touched, electrons slowly moved from the comb/balloon to the cereal. Now both objects had the same negative charge, and the cereal was repelled. Ask your child if he can think of any other ways to demonstrate static electricity.

**Day 2**

**Activity 4: Parts of a Light Bulb**

On the page called "Parts of a Light Bulb," your child will find a diagram of a light bulb. Ask him to label the parts of the light bulb using the words in the word box. He will probably be able to logically guess many of the parts. He can use an encyclopedia or other book to learn about any parts he is not sure about.

When he has finished labeling the parts, explain to him how a light bulb works. A light bulb is simply a small metal wire that is glowing with heat. When a light bulb is plugged in, electricity flows through the wire and causes it to light up. The wire is made out of a metal called tungsten, which does not melt at very high temperatures. A light bulb has most of the air sucked out of it. If it didn’t, the wire would actually burn up instantly. A light bulb burns out because the wire slowly vaporizes.
### Answer Key: Parts of a Light Bulb

<table>
<thead>
<tr>
<th>Left Column</th>
<th>Right Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. inert gas</td>
<td>1. support wires</td>
</tr>
<tr>
<td>2. tungsten filament</td>
<td>2. glass bulb</td>
</tr>
<tr>
<td>3. insulation</td>
<td>3. glass mount</td>
</tr>
<tr>
<td>4. electrical foot contact</td>
<td>4. screw thread contact</td>
</tr>
</tbody>
</table>

### Activity 5: The Invention of the Light Bulb Mini Book

Review the fact that light can be produced by electrical energy. Most of our electric light comes from light bulbs. For this activity, your child will research the invention of the light bulb. Provide him with books about the topic, or help him locate websites about the invention. He will use the pages, "The Invention of the Light Bulb Mini Book," to create a mini book that will help him present his research. On each page, he will fill in information about the light bulb and will include an illustration or graphic.

Once the pages are finished, he can cut out each of the pages and then staple them together to make a book.

**Answer Key**

Page 2: 1802, Humphry Davy (Many sites will attribute this achievement to Thomas Edison in 1879. His improvement on the light bulb was the first to achieve commercial success, but he was not the original inventor.)

Page 3: carbon

Page 4: Answers will vary but could include the type of metal in the filament, the absence of filaments in many of today’s energy efficient light bulbs, the energy efficiency of modern light bulbs, the use of light bulbs inside buildings, or how long the bulbs last.

Page 5: Answers will vary but could include incandescent, tungsten filament, carbon filament, fluorescent, compact fluorescent, or halogen.

Page 6: Answers will vary but could include enabling work at night, travel at night, communication, television, safer mining environments, night-time sporting events, etc.

**Note**

To extend this activity, your child can include additional information about the light bulb on the left side of the page of the book.

### History of the Light Bulb

**www.movingbeyondthepage.com/link/4609**

This Energy.gov page includes an interactive timeline presentation and an article that gives a history of the light bulb.

**http://energy.gov/articles/history-light-bulb**

### Timeline History of the Light Bulb

**www.movingbeyondthepage.com/link/4610**

Delmar Fans and Lights created a nicely illustrated timeline history of the light bulb.

**http://www.delmarfans.com/educate/basics/who-invented-light-bulbs/**
Electric light
www.movingbeyondthepage.com/link/4607
This Wikipedia entry gives a very detailed overview of the history of the light bulb. It will be more information than most 7-9 year old children can digest by themselves, but could be a good place for you to work with them to find information.

Different Types of Light Bulbs
www.movingbeyondthepage.com/link/4605
http://www.hgtv.com/design/decorating/design-101/light-bulbs-know-the-different-types

Wrapping Up
Ask your child what can be produced by electricity (light, sound, and heat). Ask him to describe static electricity and to explain what he learned about the light bulb.
Directions: Look at the following electrical items and group them according to whether they produce light, heat, or sound. After you have grouped the items, think of additional items you can add to each group.
Creating an Electromagnet

Question: How are electricity and magnetism related?

Materials Needed:
- 3-foot long wire
- nail
- D cell battery
- paper clips

Procedure:
1. Wrap the piece of wire tightly around the length of the nail. Leave about 6 inches at each end.

2. Try to use the nail to pick up the paperclips by touching them with the nail. What happens?

3. Attach one end of the wire to the positive terminal of the battery and the other end of the wire to the negative terminal of the battery. (see diagram)

4. Try again to pick up the paperclips. What happens? Why?

5. Now disconnect the battery and try the paperclips again. Does the same thing happen as in step 2? What has happened to the nail?
Swinging Cereal

Materials Needed:
- a plastic comb or a balloon
- thread
- small pieces of O-shaped dry cereal

Instructions:
1. Tie a piece of cereal to the end of a 12-inch piece of thread. Attach the other end of the thread to a table so that the cereal does not hang close to anything else.

2. Wash the comb with soap and dry it well or blow up the balloon.

3. Charge the comb by running it through dry, long hair several times or rubbing it vigorously on a wool sweater. Do the same with the balloon if you are using it instead.

4. Slowly bring the comb or balloon near the cereal. The cereal should swing to touch the comb or balloon. Hold the comb or balloon still until the cereal jumps away by itself.

5. Now try to touch the comb or balloon to the cereal again. The cereal will move away as the comb or balloon approaches.

What happened?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Why did this happen?

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________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
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Activity 6 - Page 1

The light bulb was invented in ________ by ________.

The first light bulbs were made from ________ in ________.
Today's light bulbs are similar in that they ______

Some different types of light bulbs include ______

The light bulb changed society because ______