Chapter 19 General Science

Electricity and Magnetism

19-1 Electricity and Magnetism

Words to Know

**electricity-** a form of energy caused by the movement of electrons

**static electricity**- the electricity caused when objects with opposite charges are attracted to each other

**discharge-** the throwing off of static electricity

Describe lightning. Does it make a sound? When? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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How is lightning like turning on a light switch? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* Describe static electricity. With your teacher’s permission, try to recreate it.

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\* *Electric* comes from Latin and means “of amber,” which is hardened resin from a tree. Amber can attract other objects if it is rubbed with fur or wool. *Electric* is the root word of *electricity* and *electrical*.

\* Think of several meanings for the word *discharge.* Look it up if you have to.

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\* Think of several meanings for battery. Look it up if you have to.

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\* Think of several meanings for circuit. Look it up if you have to.

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\* Let’s look at several examples of machines that are manually powered or electrically powered. Which for of these items is easier to use. Why?

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\* The English physician William Gilbert made the first scientific study of electricity in 1600.

\* Imagine what it would be like living without TV, radio, hair dryers, computers, washing machines, light bulbs, or telephones. Write a story about pretending that electricity does not exist. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* Until about 100 years ago, people did not know how to control electricity.

\* The loss or gain of electrons creates an electrical charge. Electricity is produced in the process.

\* Remember, inside the nucleus of an atom are protons, which have a positive charge. Circling the nucleus are electrons, which have a negative charge. Most of the time, atoms have the same number of protons and electrons. This makes them *neutral*. This means that they have no charge at all.

\* Electrons can be separated from their atoms. This electron transfer when you rub a balloon against a wall. This is what makes the balloon stick.

\* Negatively charged objects have extra electrons. When two objects are both negatively charged, they *repel* one another. This means that they push each other away or try to move apart.

\* Objects that have too few electrons are positively charged. Two positively charged objects will also repel each other.

\* Objects that have opposite charges *attract* each other. This is what causes the crackling sounds when you take clothes out of the dryer. It is what causes clothes such as socks to stick to jeans. **Static electricity** holds them together.

\* Most objects do not keep their charges for long. Negatively charged objects try to give up their extra electrons. Positively charged objects take on needed electrons to become neutral again.

\* Never use electrical appliances when you are in water or when your hands are wet. You become a *grounded object*. This means that electrons can move freely from the source of electricity to the ground. The electricity will pass right through your body and give you a harmful, even deadly, shock.

\* Electricity that results from friction usually occurs in materials that are good insulators. Therefore, electricity does not move, and thus the name *static electricity*.

\* Think again about your laundry. You might see sparks or hear a crackling noise. The sparks and noise are **discharge** of the socks and jeans returning to their neutral states.

\* *Lightning* is a huge electrical discharge. It is really just a giant spark between a cloud and the ground. This can also take place between two clouds with opposite charges or within the same cloud.

\* Clouds build electrons. It gets a large negative charge. Then, the cloud becomes attracted to something with a positive charge, such as a treetop. Suddenly, the extra electrons “jump” to the treetop. This creates a lot of light and heat. The light is the bolt of lightning. The heat warms the air and causes the air to expand very quickly. This quick expansion causes the loud boom called *thunder*.

19-2 Electrical Currents

**electrical conductor**- a material that electricity travels through easily

**electrical insulator**- a material that electricity does not travel through easily.

**battery-** a device that changes chemical energy into electrical energy

**generator-** a machine that changes some other kind of energy into electrical energy

\* Heat moves through some materials better than others. The same is true for electricity.

\* Metals are excellent conductors. Metal wire is often used to conduct electricity. Many other substances can conduct electricity. Even your body can conduct electricity.

\* Gold and other metals are in high demand. They are used in many pieces of electrical equipment because of their ability to conduct electricity.

\* Your body actually creates electricity, albeit a very small amount. In fact, too much electricity sent through your body can kill you.

\* Rubber and plastic, however, are good electrical insulators. Electrical tape, for example, is made from a plastic called vinyl. This is the same material used on old records (albums) from when I was a baby.

\* Rubber coating on wires leading from your television to the plug is an insulator. It is what keeps you from getting electrocuted.

\* To get electrons to move through a conductor, people often use a **battery**.

\* One kind of battery is a *wet cell*. A wet cell, such as a car battery, is actually made up of a series of wet cells. Each cell contains two kinds of metal plates and an acid solution. Chemical reactions between the plates and the acid cause electrons to build up at the cell’s negative pole. When the negative and positive poles are connected, electrons flow.

\* Another kind of battery is a *dry cell*. Most batteries you use for flashlights, smoke alarms, and CD players are dry cells. A dry cell uses past instead of an acid solution. A chemical reaction between the metal case and the paste causes electrons to build up on the metal, making it negative. The rod in the middle of the cell becomes positive. Current flows when the two poles are connected, such as by a wire or other conductor.

\* A single dry cell is commonly called a battery. Technically, however, a battery consists of two or more cells connected. For example, three dry cells connected in a flashlight make up one battery.

\* A **generator** is sometimes used instead of a battery to start the flow of electrons. Some generators turn mechanical energy into electrical energy. Other generators turn heat energy into electrical energy.

19-3 Electrical Currents

**circuit**- an unbroken, circular path that an electrical current flows through; includes a source of energy, such as a battery

**fuse**- a weak link in an electrical circuit; made of metal wire that has a low melting point

\* When you open and close a switch, a light goes on and off. Why is this?

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\* Many things at your house are powered by electricity. Name as many as you can.

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\* How do you think the appliance work and the amount of electricity is controlled?

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\* The trick to making electricity useful is getting it flow in a certain direction. Electricians set up paths that electrical current flows through. These paths are circular. They flow in a circle and come back to the place where they start without being broken anywhere along the way. This is called a **circuit**.

\* Circuits always include a source of energy, such as a battery.

\* Look at the picture on page 288 of your textbook. This is a closed electrical circuit.

\* It connects a battery to a light. The battery produces the electricity, which flows through the wires.

\* As it passes through the light bulb, the electricity heats a piece of material called a *filament.*

\* The filament gets so hot that it actually glows. This produces the light. The electricity continues along the circuit back into the battery.

\* Have you ever felt a light bulb? Why do you think this is? Well, some of the electricity used to light the filament turns into heat energy. That heat energy is lost from the circuit. Before long, the battery will run out of energy.

\* Some circuits have switches. If the switch is turned off, the switch is *open*. That means that a gap is formed in the circuit. The electricity cannot flow.

\* If the switch is turned on, the circuit is *closed*. Now the electricity can flow.

\* When too many electrical appliances are put on one circuit, it can become *overloaded*. Too much electricity is running through the wire. An overloaded circuit can cause the wire to get too hot and start a fire.

\* If the wires that connect to the battery are switched, the current of electrons will flow in the opposite direction through the circuit. The bulb will still glow, however.

\* In my house, the wires were all connected backwards. This is OK as long as all of the wires are done the same way.

\* **Fuses** are used to prevent overloaded circuits from causing fires. These are made of metal wires that have a low melting point. When too much electricity flows through the wire, the fuse melts. When the fuse melts, the circuit is broken, and the flow of electricity stops.

\* Fuses are commonly used to protect appliances, such as stereos and microwave ovens. Each fuse is rated according to the maximum amount of current that can pass through it without melting it.

\* Most new homes are protected by circuit breakers instead of fuses. A circuit breaker has a switch that turns off when too much electricity flows though the circuit.

Here is a site for some cool facts about electricity.

<http://kids.saveonenergy.ca/en/what-is-electricity/did_you_know.html>

Try some fun games about electricity at the following website.

http://www.sciencekids.co.nz/gamesactivities/circuitsconductors.html

19-4 Magnetism

**magnet-** a solid substance that attracts iron or steel

**magnetic field**- the area around a magnet in which a magnetic force is active

\* What is a magnet? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\* What do you think a magnet is made of? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\* Why do you think a magnet does what it does? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* What do you use magnets for? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* We will take a few minutes to use our NASA magnets.

\* More than 2,000 years ago, the Greeks discovered that certain stones had special properties. These stones, called *lodestones*, naturally attracted each other.

\* Any stone, piece of metal, or solid substance that attracts iron or steel is called a **magnet**.

\**Magnetism* is the state of being magnetized.

\* All matter is magnetic. However, only the elements iron, nickel, and cobalt have strong magnetism.

\* Each end of a magnet is called a *pole*. If you hang a bar magnet on a string and let it swing freely, one end of the magnet will point toward the north. The other end will point towards the south.

\* Magnetic poles act like electrical charges do. Like poles repel each other. Opposite poles attract each other.

\* The magnetic force is the strongest at the poles. However, it can be felt all around the magnet.

\* The area in which a magnetic force is active is called the **magnetic field**.

\* At the magnetic poles, the magnetic field is vertical, and a compass ceases to indicate direction along the ground.

\* Electrons are like tiny magnets. They spin around the nucleus of an atom in no particular order. So, their magnetic pull is in all different directions.

\* Tiny magnetic fields turn so that all the north poles face north. Because the magnetic pull is all one direction, it is a lot stronger.

\* You can stir up the tiny magnetic fields of a magnet’s electrons by hammering or heating the object. This causes the object to lose its magnetism.

We will try the games at the following website:

<http://www.sciencekids.co.nz/gamesactivities/magnetssprings.html>

We will complete several missions at the following website.

<http://www.engineeringinteract.org/interact.htm>