3 How Are Electricity and Magnetism Related?

LESSON GOALS

You will learn
- how a magnet can be used to make electricity.
- how electricity can be used to make a magnet.
- some uses of electromagnets.

generator (jen′ə rā′tər), a machine that uses an energy source and a magnet to make electricity.

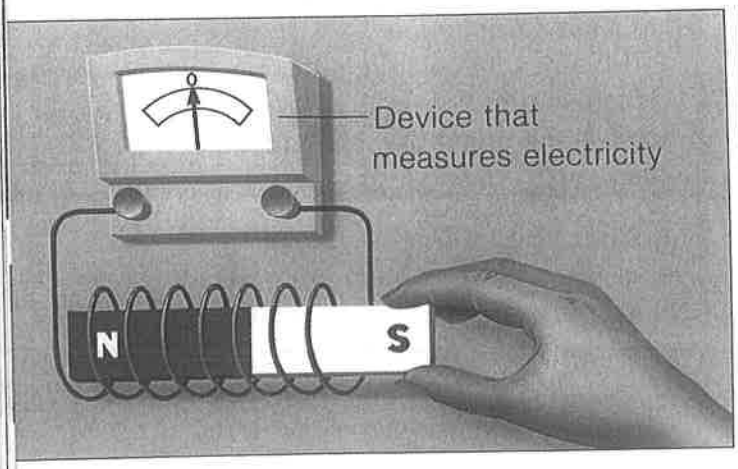
About 170 years ago, scientists learned that electricity can make magnetism. They also learned that magnetism can be used to make electricity. Today, the electricity you use and many useful machines come from these discoveries.

Making Electricity from Magnets

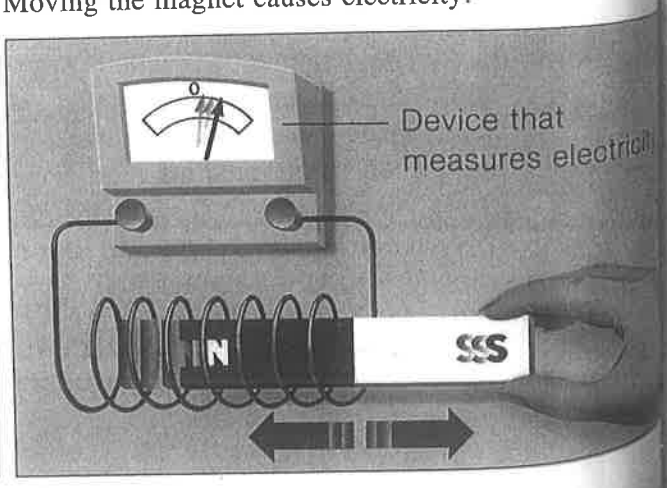
Find the wire and magnet in the pictures. The wire is hooked to a device that measures electricity. Notice in the first picture that the pointer is on 0. The magnet is not causing any electric current to flow. In the second picture, the person moved the magnet through the loops of wire. Notice that the pointer shows an electric current moving through the wire. The magnet moving through the loops of wire makes electricity. You could also make electricity by moving the loops of wire instead of the magnet.

Electric **generators** are machines that use magnets and loops of wires to make electricity. Generators need energy to move the magnets or loops of wire. Coal, gas, oil, and moving water are some sources of this energy. Generators make almost all the electricity that people use.

The measuring device shows no electricity.



Moving the magnet causes electricity.



Making Magnets from Electricity

An electric current moving through a wire causes a magnetic field around the wire. If the wire is shaped into loops, the magnetic field gets stronger. Notice in the picture that the loop of wire has a north pole and a south pole. An electric current running through a loop of wire makes an **electromagnet.** If the electric current is shut off, the electromagnet is no longer magnetic. The electromagnet is turned off.

An electromagnet usually has a piece of iron in its center. When current runs through the wire, the wire and the iron become magnetic. The magnetic field of the iron is added to the magnetic field of the wire. The electromagnet becomes stronger.

The student in the picture is using electricity to make a magnet. She wrapped wire around a large nail. Then she connected each end of the wire to a battery. As you can see, the nail can now pick up paper clips. The student has made an electromagnet. What will happen to the nail when the wire is unhooked?

SCIENCE IN YOUR LIFE

If you have a light on your bicycle that goes on when you pedal, you have a generator. Your muscles provide the energy when you pedal. The bicycle's wheel turns a part that makes a loop of wire move in the magnetic field of a magnet. The electricity produced makes the light on the bicycle glow.

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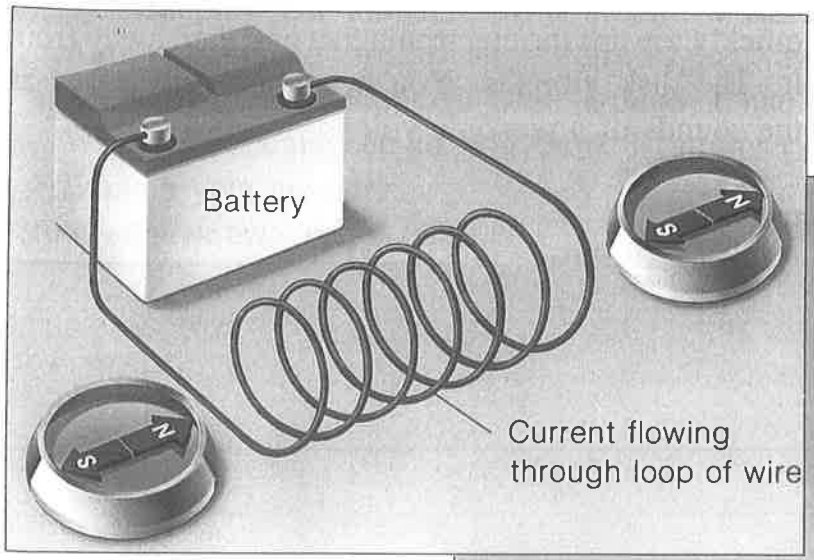
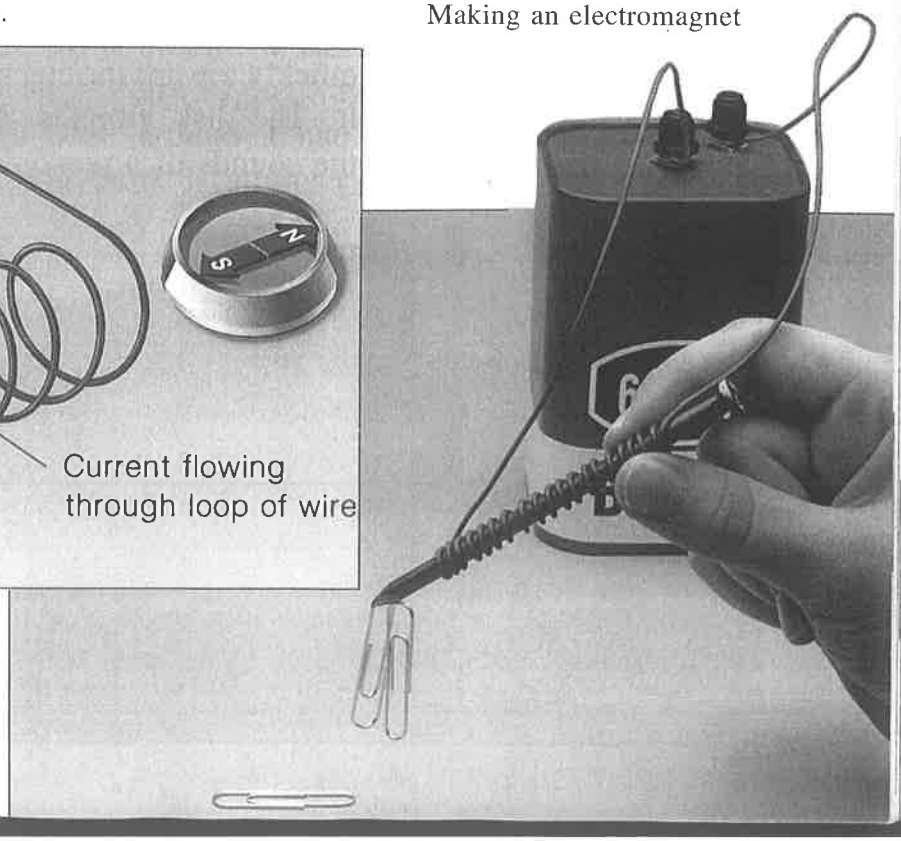
electromagnet (i lek′trō mag′nit), a magnet made when an electric current flows through a wire.

A current makes the wire magnetic.



Making an electromagnet



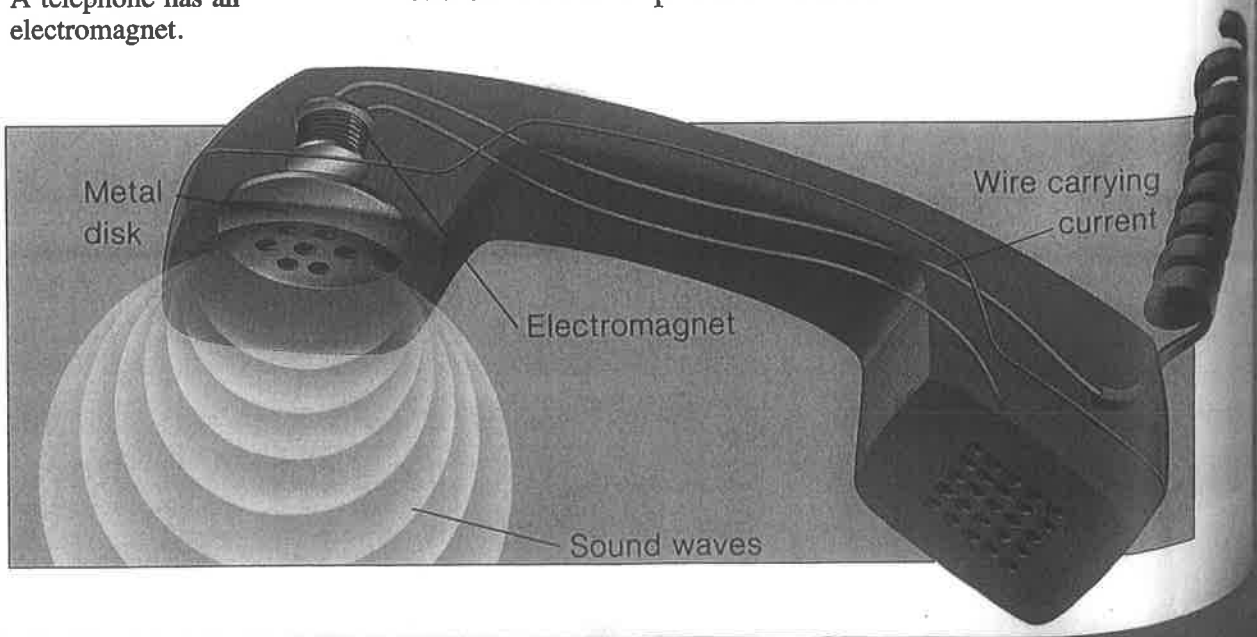
How Electromagnets Are Useful

Sometimes magnetism is needed only part of the time. Because electromagnets can be turned on and off, they are sometimes more useful than ordinary magnets. For example, a crane has an electromagnet on it. When current moves through it, the electromagnet can pick up scrap metal. When the current is off, the electromagnet loses its magnetism. The crane drops the scrap metal.

Electromagnets also have many uses in homes. When you push the button on a doorbell, you close a circuit. Current moves through a wire loop in the doorbell. The wire becomes an electromagnet. It pushes away an ordinary magnet. Something attached to the ordinary magnet hits a bell.

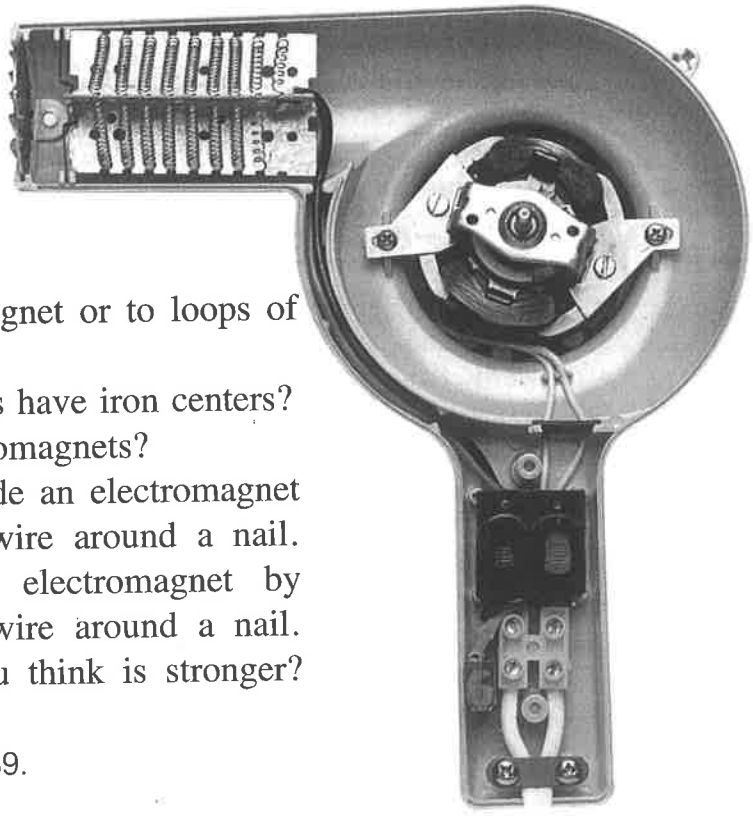
A telephone works because of an electromagnet. Find the electromagnet in the telephone below. Sound travels through the telephone wire as an electric current. This electric current changes as a person's voice changes. The electromagnet becomes stronger and weaker with the changing current. Find the metal disk in the telephone. The changing strength of this electromagnet causes the disk to move quickly toward the electromagnet and then away from it. The disk vibrates. You hear these vibrations as the sounds of a person's voice.

A telephone has an electromagnet.



Electric motors also use electromagnets. Factories use electric motors to run machines. You use electric motors of many sizes in your home. Hair dryers, refrigerators, and air conditioners have electric motors. Find the wires in the electric motor in the center of the hair dryer below.

Scientists also use electromagnets. Some of these electromagnets are each about 5 meters long. Scientists use more than 1000 electromagnets this size to help them study the tiny bits inside atoms.



The inside of a hair dryer has an electric motor.

Lesson Review

1. What has to happen to a magnet or to loops of wire to make electricity?
2. Why do many electromagnets have iron centers?
3. What are three uses of electromagnets?
4. **Challenge!** One student made an electromagnet by wrapping ten loops of wire around a nail. Another student made an electromagnet by wrapping twenty loops of wire around a nail. Which electromagnet do you think is stronger? Explain your answer.

Study on your own, pages 388–389.

PHYSICAL SCIENCE

FIND OUT ON YOUR OWN

Use books in the library to find out about a famous scientist who made an important discovery about electricity or magnetism. You might find out about Michael Faraday, Hans Christian Oersted, Thomas Edison, Lewis Latimer, or another scientist. Write a paragraph telling about the scientist and the discovery.