

What's the Big Idea?

You will learn:

- how electricity and magnetism are related.
- how generators use magnets to produce electricity.
- what energy sources generators use.

Lesson 3

What Produces the Electricity Used in the Home?

Whew! Ever pedal a generator at a science museum? You work very hard to just light a bulb. After a few minutes, you're so tired you have to stop. You wonder, "How does this thing change my hard work into electrical energy?"

Magnetism Produces Electricity

History of Science



Did you know that electricity and magnetism are closely related? Scientists did not clearly understand that they are really two parts of the same thing until the 1800s. Electricity can make magnetism, and magnetism can make electricity.

Scientists learned about magnetism first. In the ancient Greek town of Magnesia, they discovered a stone with an unusual property—iron would cling to it! Later, scientists discovered the basic principles of magnetism that you know. Study them in the chart below. Compare the principles of magnetism and electricity.

Magnetism

- Two opposite poles attract: N attracts S.
- Like poles repel: N repels N, and S repels S.
- Magnetic forces can attract and repel at a distance, without touching.
- Magnetism can make electricity.

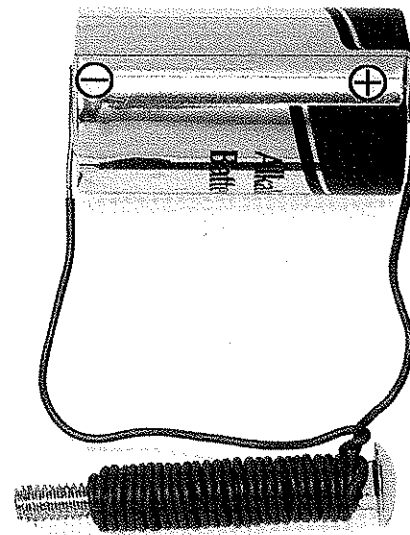
Electricity

- Two opposite charges attract: + attracts -.
- Like charges repel: + repels +, and - repels -.
- Electric forces can attract and repel at a distance, without touching.
- Electricity can make magnetism.

As you can see, the principles of magnetism and the principles of electricity are similar. Scientists in the 1800s thought so too. They investigated. First, they discovered that electricity could produce magnetism. When electricity flows through a wire, the wire becomes magnetic. Perhaps you have made an electromagnet like the one on the right.

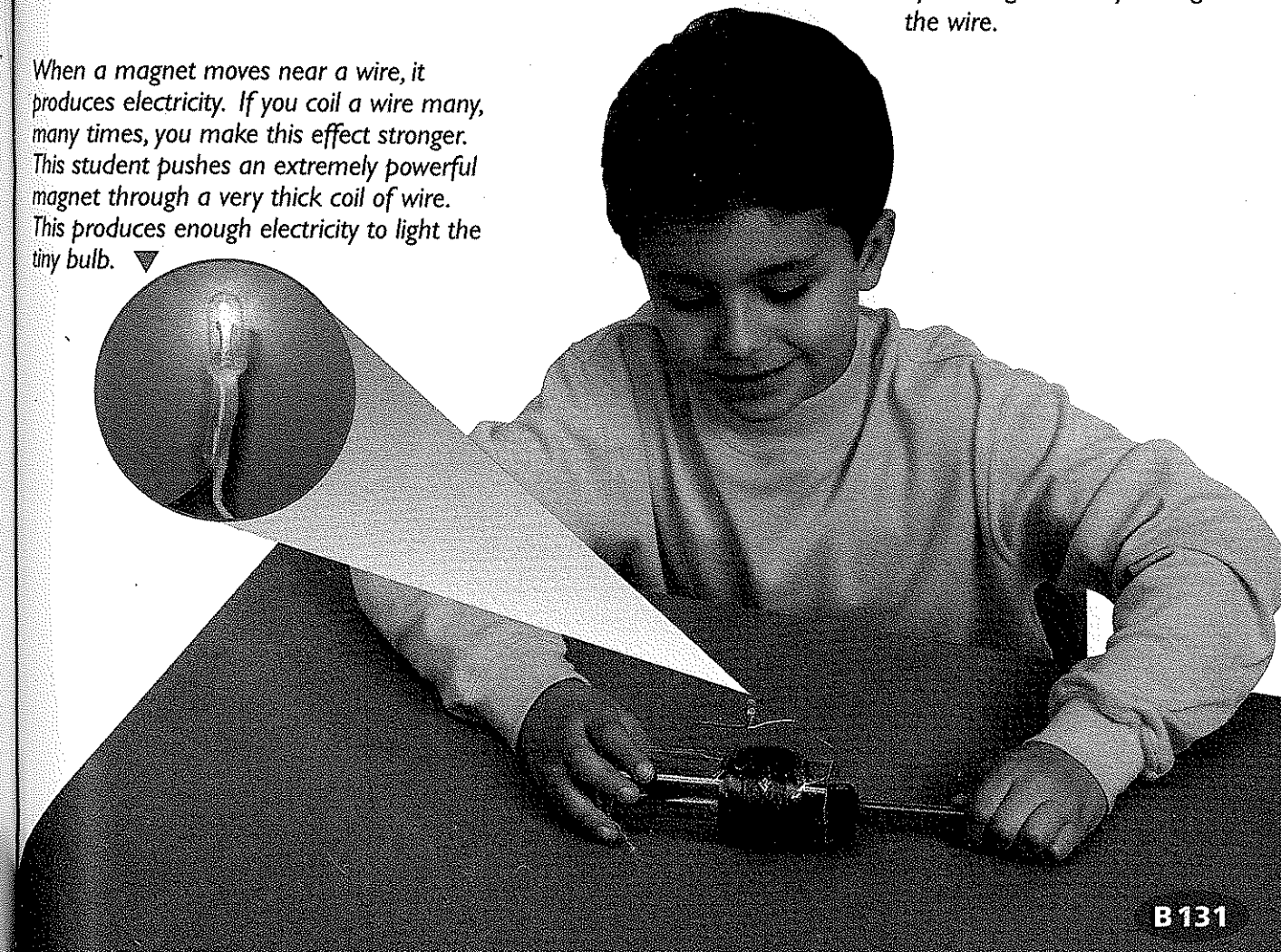
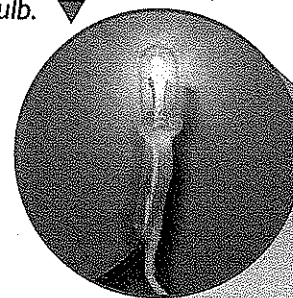
Later, scientists discovered that magnetism can make electricity. If you move a magnet near a wire, the motion of the magnet causes electrons to flow in the wire. In the science museum demonstration shown below, the volunteer moves a very powerful magnet through a thick coil of wire and produces enough electricity to light the tiny bulb.

Scientists used the discovery that magnetism can produce electricity to invent a device that could make large amounts of electricity cheaply. This device changed the world. Turn the page to learn what this device is and how it works.



▲ An electromagnet uses electricity to make magnetism. When electricity moves in a wire, it produces magnetism. If you coil a wire around a bolt many, many times, you make this effect much stronger. You turn on the electromagnet by sending electricity through the wire.

When a magnet moves near a wire, it produces electricity. If you coil a wire many, many times, you make this effect stronger. This student pushes an extremely powerful magnet through a very thick coil of wire. This produces enough electricity to light the tiny bulb. ▼



Glossary

generator
(jen'ə rā'tər), a device that uses a magnet to change mechanical energy into electrical energy

How Generators Work

Once scientists discovered that magnetism could produce electricity, they developed electrical generators. A **generator** is a device that uses a magnet to change mechanical energy into electrical energy.

Some generators produce electricity by moving a coil of wire near a magnet. Other generators move the magnet instead, and the coil doesn't move. That's how the generators shown on these pages work. Study the generator on the next page. Find the three basic parts of the generator and discover what each does.

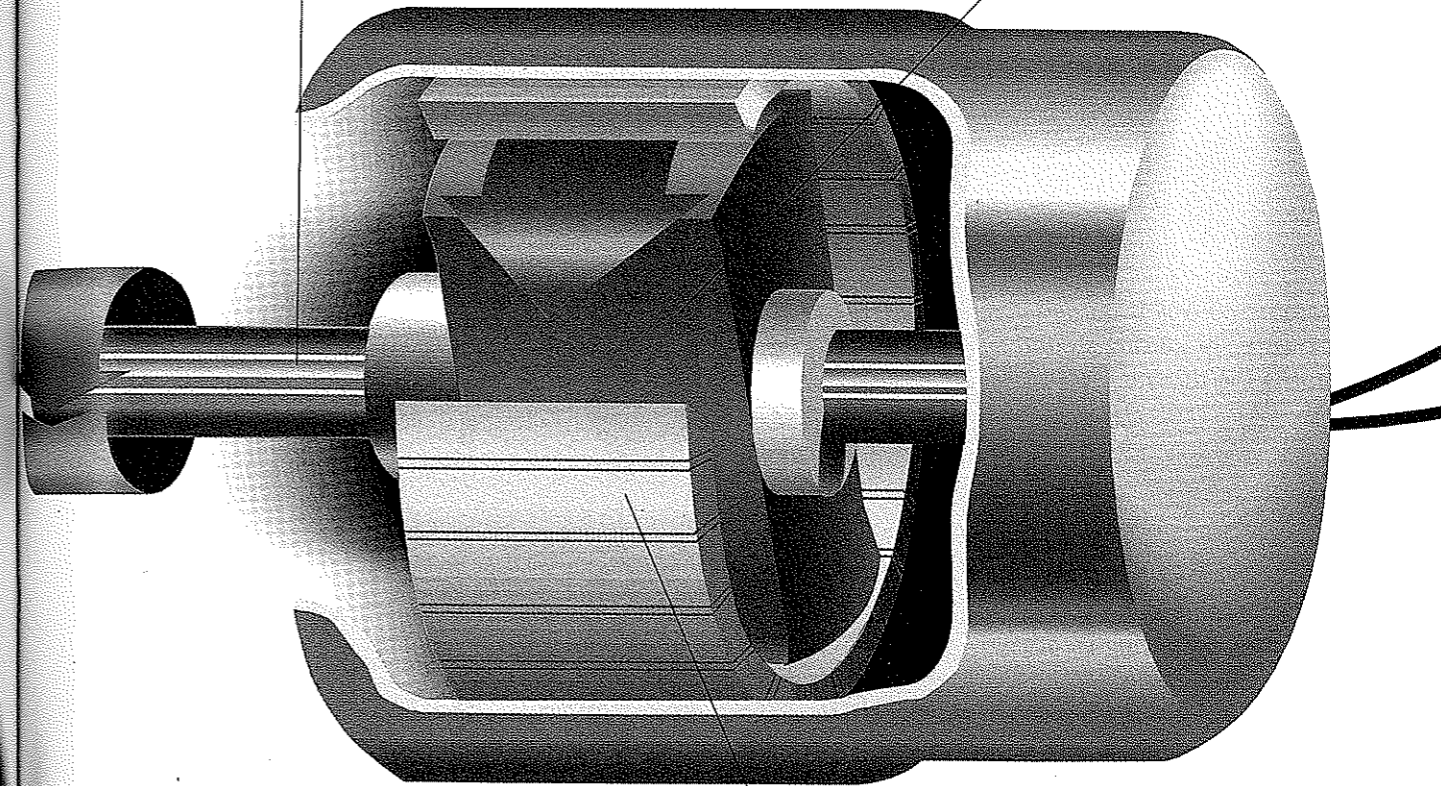
Moving water is the source of mechanical energy that turns the magnets in this generator. ▼

**A Generator****Drive Shaft**

The drive shaft is connected to the magnet inside the coil of wire. A source of energy is needed to turn the drive shaft and the magnet.

Strong Magnet

This strong magnet turns inside a large coil of wire. Most generators use electromagnets instead of regular magnets.

**Coil of Wire**

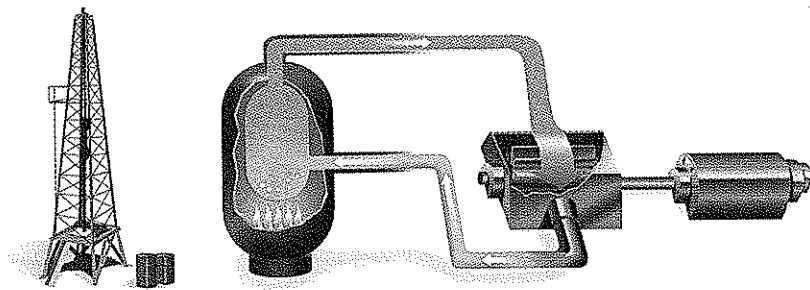
The moving magnet makes electrons flow in the coil of wire. This is an electric current. It is carried by wires to where it is needed.

Powering Generators

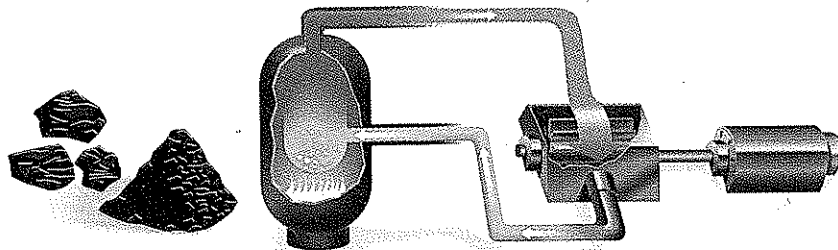
Different sources of energy can be used to turn a generator's drive shaft and produce electricity. Notice in each of the pictures below that the generator's drive shaft attaches to a turbine. Like a pinwheel that spins when air rushes past it, each turbine below spins as steam or water moves through it. This spins the drive shaft. The drive shaft turns a magnet inside a coil of wire in the generator. Electricity is produced.

An energy source is used to turn a turbine. The turbine turns a drive shaft. The drive shaft turns a magnet in a generator. The generator makes electricity that is delivered by power lines to homes and businesses. Trace these steps for each energy source shown below. ▼

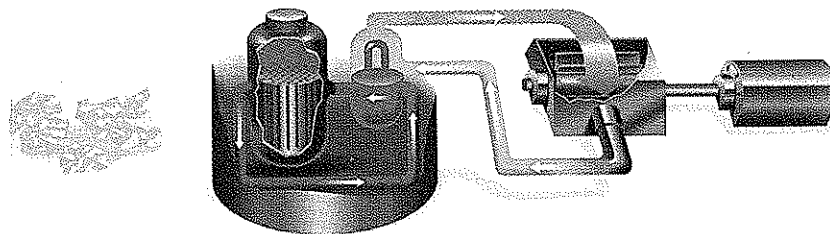
Oil from an oil well is burned to boil water, producing steam that turns the turbine. ▼



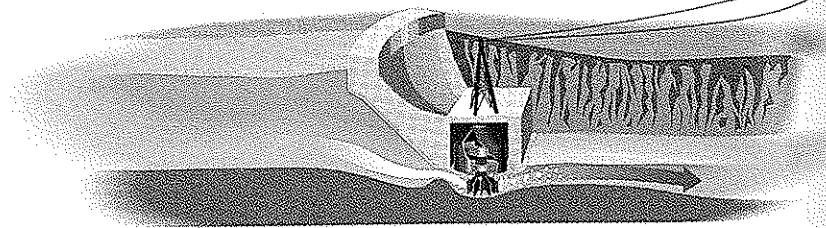
Coal from a mine is burned to boil water, producing steam that turns the turbine. ▼



Uranium ore from a mine is used in a nuclear reactor to boil water, producing steam that turns the turbine. ▼

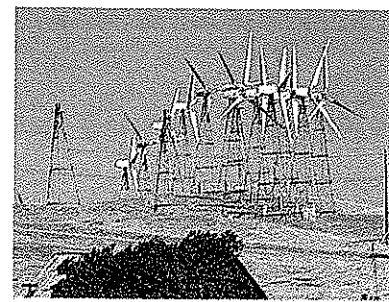


A river flows into a dam. The energy of moving water turns the turbine. ▼

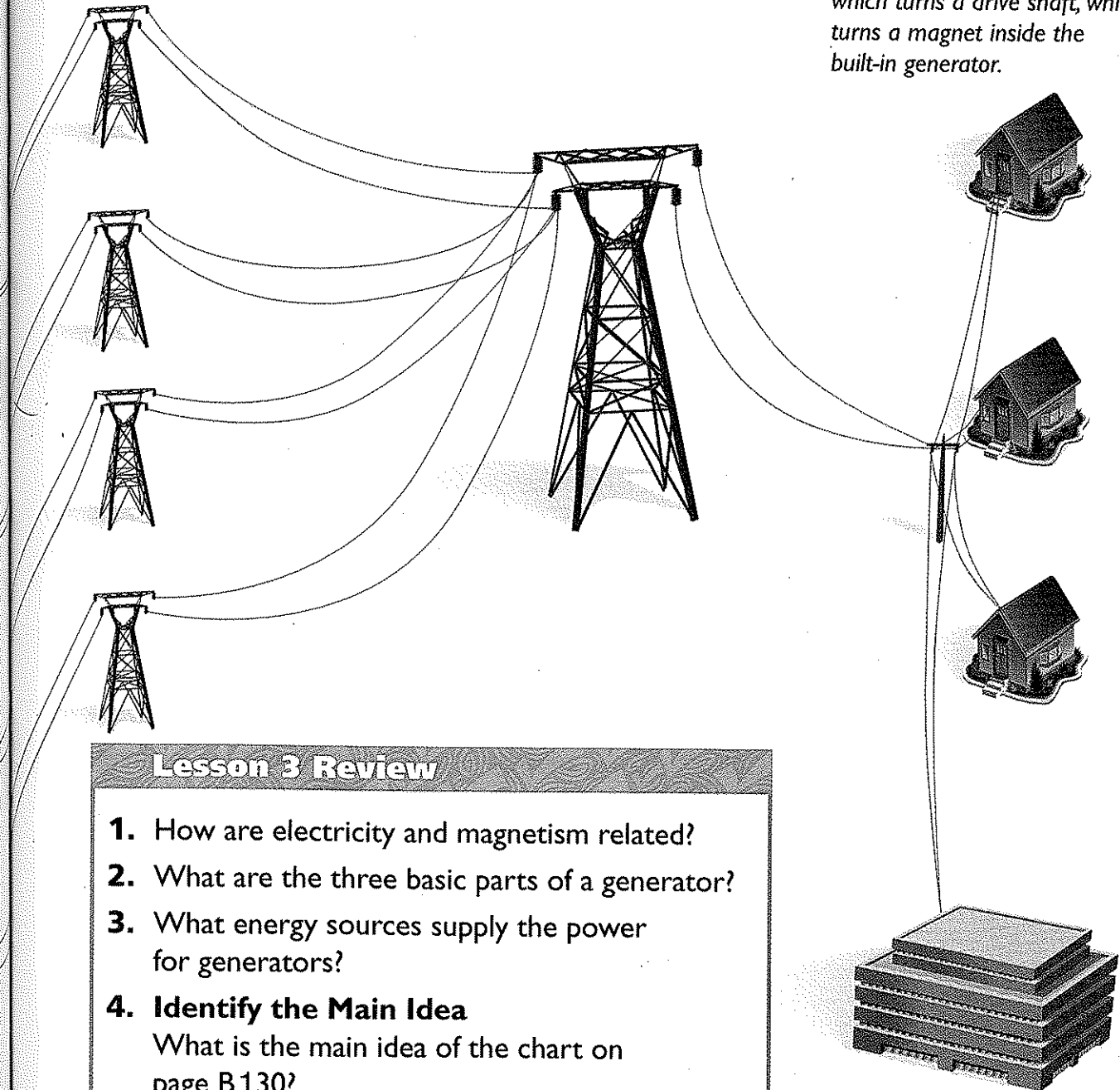


A few power plants use tides or waves as their energy source. Modern windmills, such as those to the right, use wind energy to spin built-in generators. Altogether, generators produce almost all the electricity people use.

Some devices produce electricity without a generator. Batteries change chemical energy directly into electrical energy. Special solar panels change light energy directly into electrical energy.



▲ The blades of a modern windmill act like a turbine. Wind energy turns the turbine, which turns a drive shaft, which turns a magnet inside the built-in generator.



Lesson 3 Review

1. How are electricity and magnetism related?
2. What are the three basic parts of a generator?
3. What energy sources supply the power for generators?
4. **Identify the Main Idea**
What is the main idea of the chart on page B130?