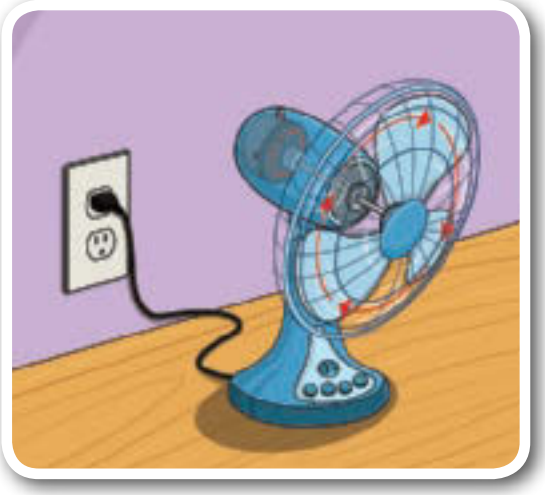
Core Knowledge® SCIENCE

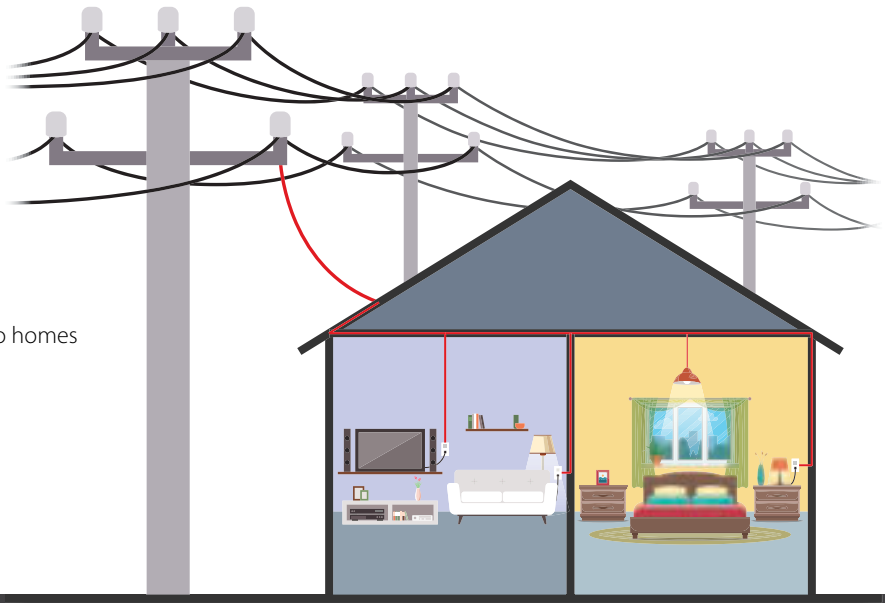
current electricity

Electricity and Magnetism

static electricity



magnets and motion



electricity to homes

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Electricity and Magnetism

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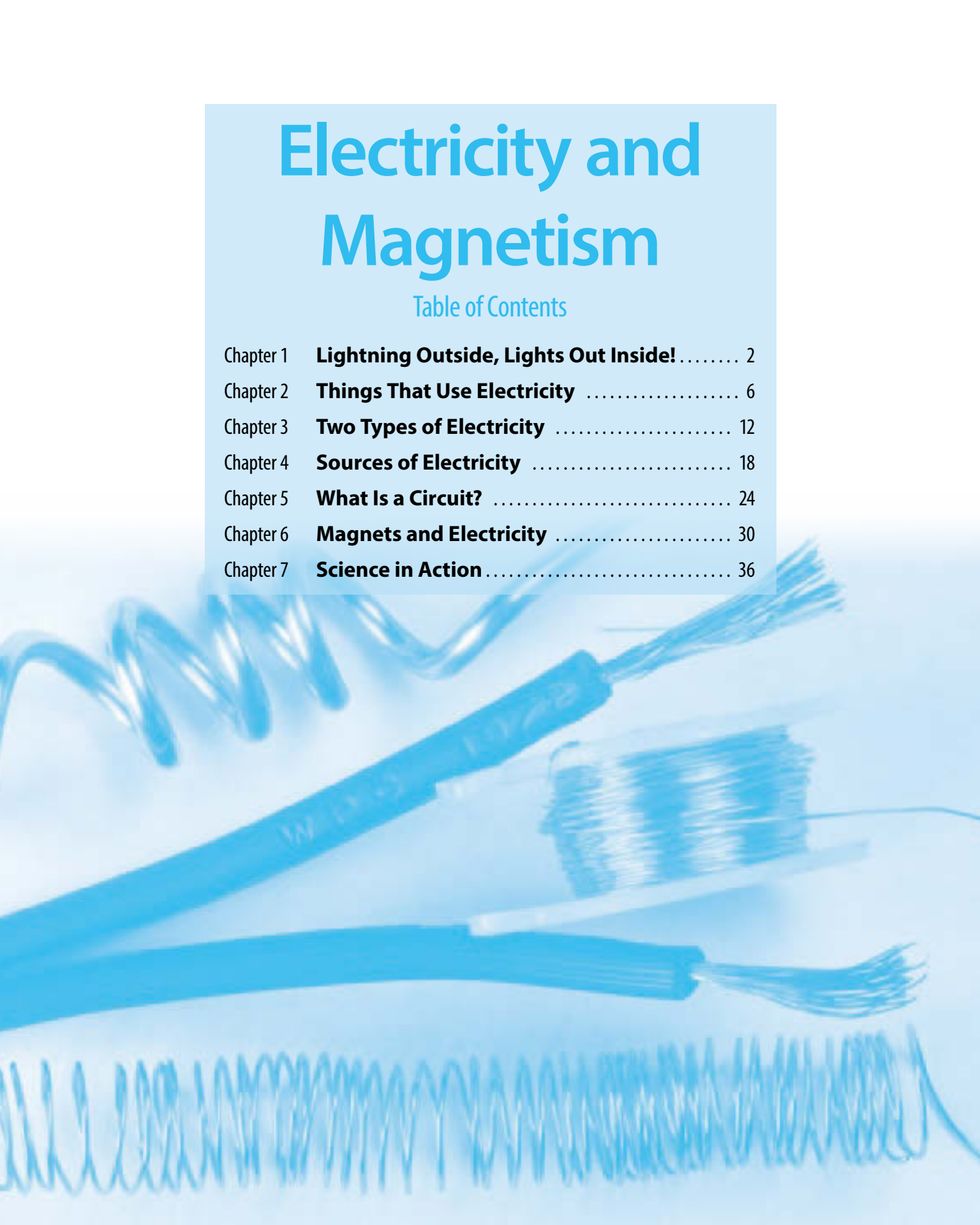


CHAPTER
1

Lightning Outside, Lights Out Inside!

Eva is setting the table for dinner. *Flash, flash, kaboom!!* It is a stormy evening. Outside it is windy and raining. Lightning flashes, and thunder rumbles.

Mom and Dad are in the kitchen cooking. Another zigzag of lightning brightens the sky. A loud crack of thunder sounds right after the flash. Suddenly, the lights in Eva's house flicker and go out!

The television in the living room has gone silent. In the kitchen, the microwave has stopped. The lights on the stove have gone dark. Even the hum of the refrigerator has stopped. "What just happened?" Eva asks Mom and Dad.

"The electrical storm has caused the power to go out," Dad replies.

"A tree limb might have fallen on some electric lines," Mom adds. "Or lightning might have struck a utility pole."

“Mom, you’re an electrician. Can you make the lights come back on?” Eva asks.

“Not right now,” Mom says. “It looks like the electricity is out all over the neighborhood.” Eva joins Mom at the window. They don’t see any lights on in any of the houses on their block. Even the streetlights have gone out. The only light outside comes from the flickering lightning.

"It's a good thing we made dinner already," Dad says. "All of our kitchen appliances are electric. We can't do any more cooking until the electricity comes back on."

"Tonight, we will dine by candlelight!" Mom says. "After dinner, we will find things to do that don't need electricity."

Eva tries to think of what they can do with it raining outside and no electricity in the house. Every activity she can think of inside the dark house depends on electricity in some way!

CHAPTER 2

Things That Use Electricity

Eva and Mom decide to play a game while the electricity is off. They will list all the things they can find that need electricity to work. They will go from room to room.

Eva has an idea about how to start the list. She will look for each electrical wall socket that has something plugged into it.

SAFETY

Electricity can be dangerous. Never put anything into an electrical socket. Only adults should plug electrical cords into wall sockets or remove them.

In the kitchen, Eva spots the coffee pot and toaster. Both are plugged into electrical sockets. She looks behind the microwave and sees that it is plugged in, too.

Eva doesn't see a plug for the stove. But she knows that the stove must need electricity, because Dad said it wouldn't work while the power was out. Mom tells Eva that the stove and the refrigerator are both plugged into electrical sockets behind the appliances. Eva puts those on the list.

In the living room, Eva sees the lamp plugged into an electrical socket. The TV and her video game console are also plugged in. So is the computer.

"Mom," Eva asks, "what about the ceiling fan and light? They don't work while the electricity is off, but I don't see where they are plugged in."

"They are connected directly to the house's electric wires inside the ceiling," Mom answers.

In the bathroom, Eva lists the light and fan as two things that need electricity. Mom tells her to keep looking. Then Eva remembers the hair dryer in the cabinet. It has a cord to plug in. So does the curling iron Mom sometimes uses on her hair.

Eva also adds their electric toothbrushes and Dad's electric shaver to her list. These items are a little different from the other electric things she has listed so far. They recharge when they are plugged in, but they don't have to remain plugged in all the time to work.

In Eva's bedroom, she lists a lamp. Eva has a tabletop fan that plugs in. She also has a nightlight that helps her see if she needs to get out of bed in the night.

Mom leads the way to the garage, where they will find even more electric items. The lawn mower has a long orange cord. The light over the workbench is also electric. So are all the power tools that Mom uses. There is a drill and a saw. Even their garage door needs electricity to open and close. So many things need electricity to work!

CHAPTER
3

Two Types of Electricity

Eva has some questions about what is going on this evening. Dad called the storm outside an electrical storm. But the storm made the electricity in the house go out.

"Mom, why is it called an electrical storm if it makes our electricity *stop* working?" Eva asks. Another question pops into Eva's mind. "Mom," she asks, "you are an electrician, right? So why can't you fix our electricity tonight?"

Mom smiles. “Those are great questions,” she says. Mom explains that there are two types of electricity. One type is called static electricity, and the other type is current electricity.

Static electricity occurs on the surfaces of objects. Two materials that are rubbed together may become charged with static electricity. When you rub a balloon on your hair it can cause your hair to stick out!

The electricity that appliances use in homes is current electricity. Current electricity flows through wires.

You may have felt a spark of static electricity when you touched a doorknob. If you shuffle your feet across a carpet and then hold one finger close to a doorknob, you might see a little spark of light and hear a “click” sound. You may also feel a little sting or tingle!

The surface of a cloud may become charged with static electricity, too. Lightning is a VERY big spark of static electricity. The spark often jumps between clouds. Sometimes the spark jumps from a cloud to the ground. Danger! This is the reason thunderstorms are also called electrical storms.

SAFETY

Stay indoors during lightning storms.

Current electricity is different from static electricity. Electricity in a current exists in wires. Current electricity connects to homes through big wires called power lines.

Sometimes during storms, tree limbs fall on power lines and break them. Lightning can damage the wires that bring current electricity to homes. When electric current can't reach homes, the homes lose power. This has happened at Eva's family's house.

People who work for the power company must find where the power lines are broken and fix the wires.

CHAPTER
4

Sources of Electricity

Dad has found some flashlights to help the family see in the dark house. He turns one on. He gives one to Eva and one to Mom. Eva's flashlight will not turn on.

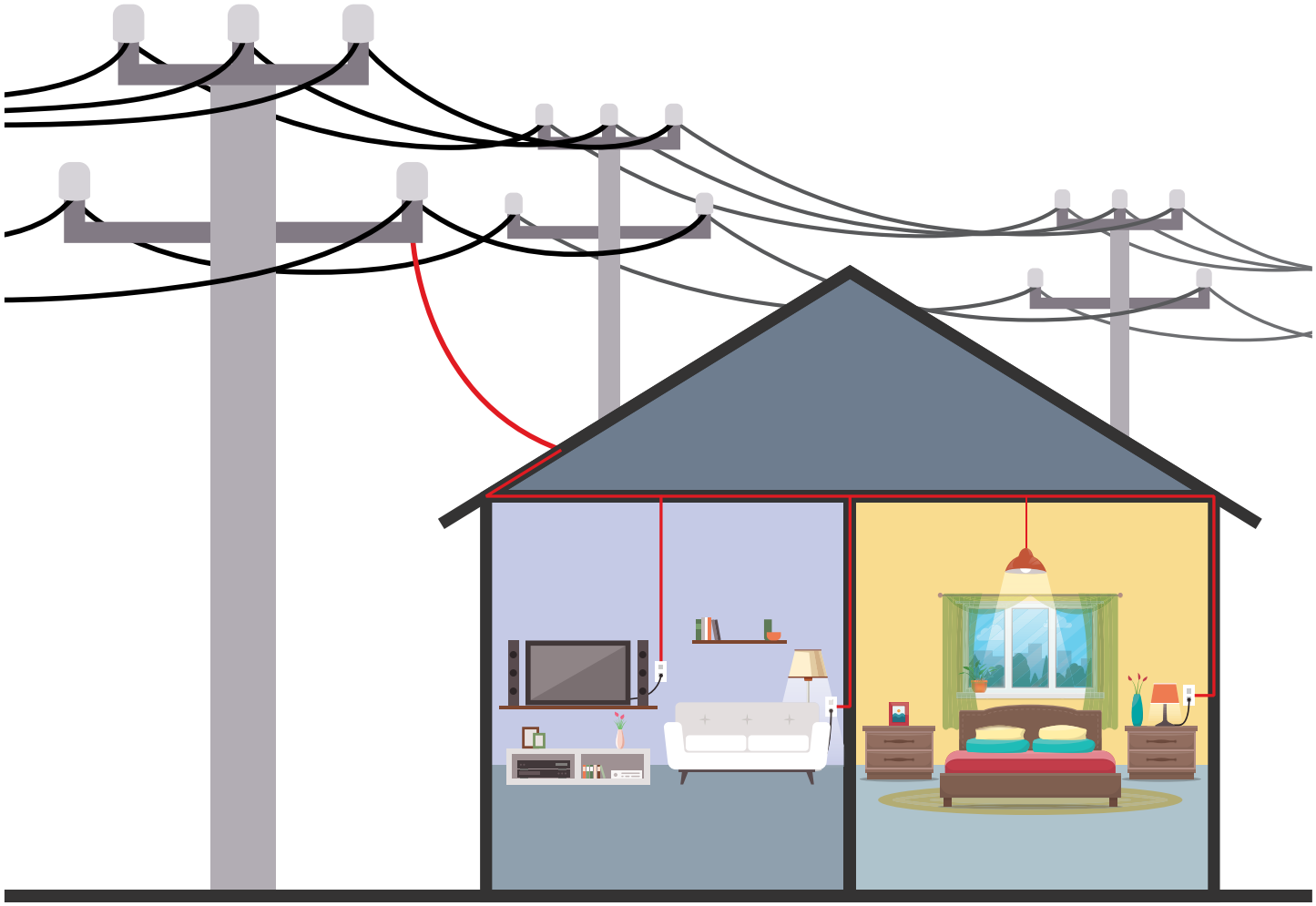
"That one must need new batteries," Mom says. "Here, you can use the hand-crank flashlight. Turning the crank produces the electricity to light the bulb."

“There is no power in the house. How come these flashlights work? Don’t all light bulbs need electricity?”, asks Eva.

“Yes, they do,” Mom replies. “But a flashlight is an example of current electricity, too. The bulb in my flashlight gets its electricity from the batteries. Things that operate using electricity all have to get the electricity from some source.”

Mom explains more. The electricity that is delivered to most homes and other buildings is produced in power plants. Current electricity from power plants is present in power lines. The power lines connect to the many buildings in a community.

Power lines are connected to a house, and current electricity powers all the sockets and appliances. The current is present in wires inside the walls of the home. Lights and other appliances get electricity by being connected to the house's wiring. Plugging a lamp into an electrical socket connects the lamp to the house's electricity.



In a similar way, when Mom turns on her flashlight, she allows current electricity to exist and the light to go on.

Compared to a power plant, a battery produces a small amount of current electricity. The electricity produced by a battery runs out. It does not last forever. When the battery dies, it needs to be replaced.

Some batteries can be recharged, though. They can be plugged in to connect to the current electricity in the house. Cordless items, such as cell phones and laptop computers, have rechargeable batteries inside of them.

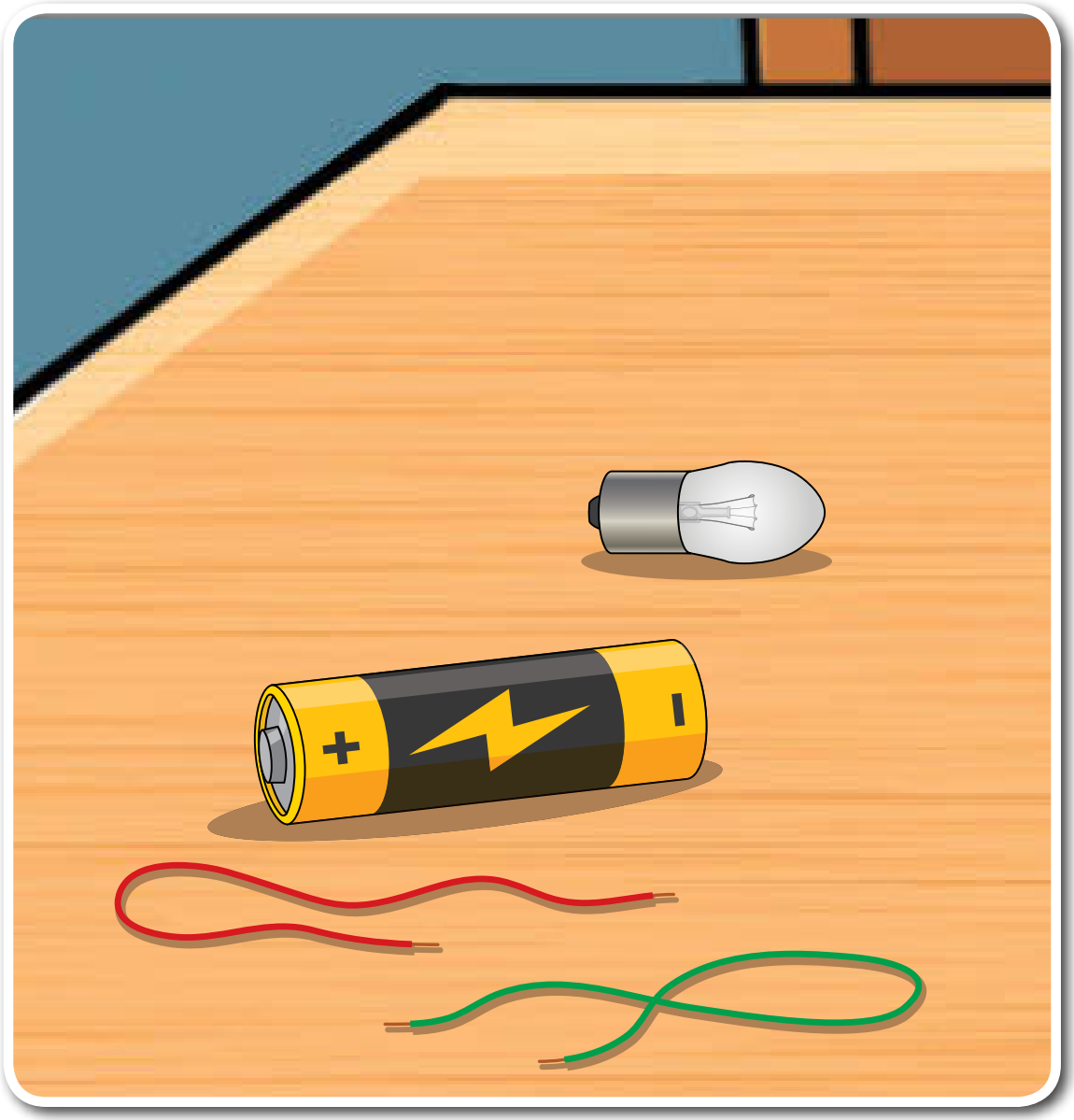
The electric toothbrush and Dad's shaver in Eva's bathroom are two more electric items with rechargeable batteries inside.

CHAPTER
5

What Is a Circuit?

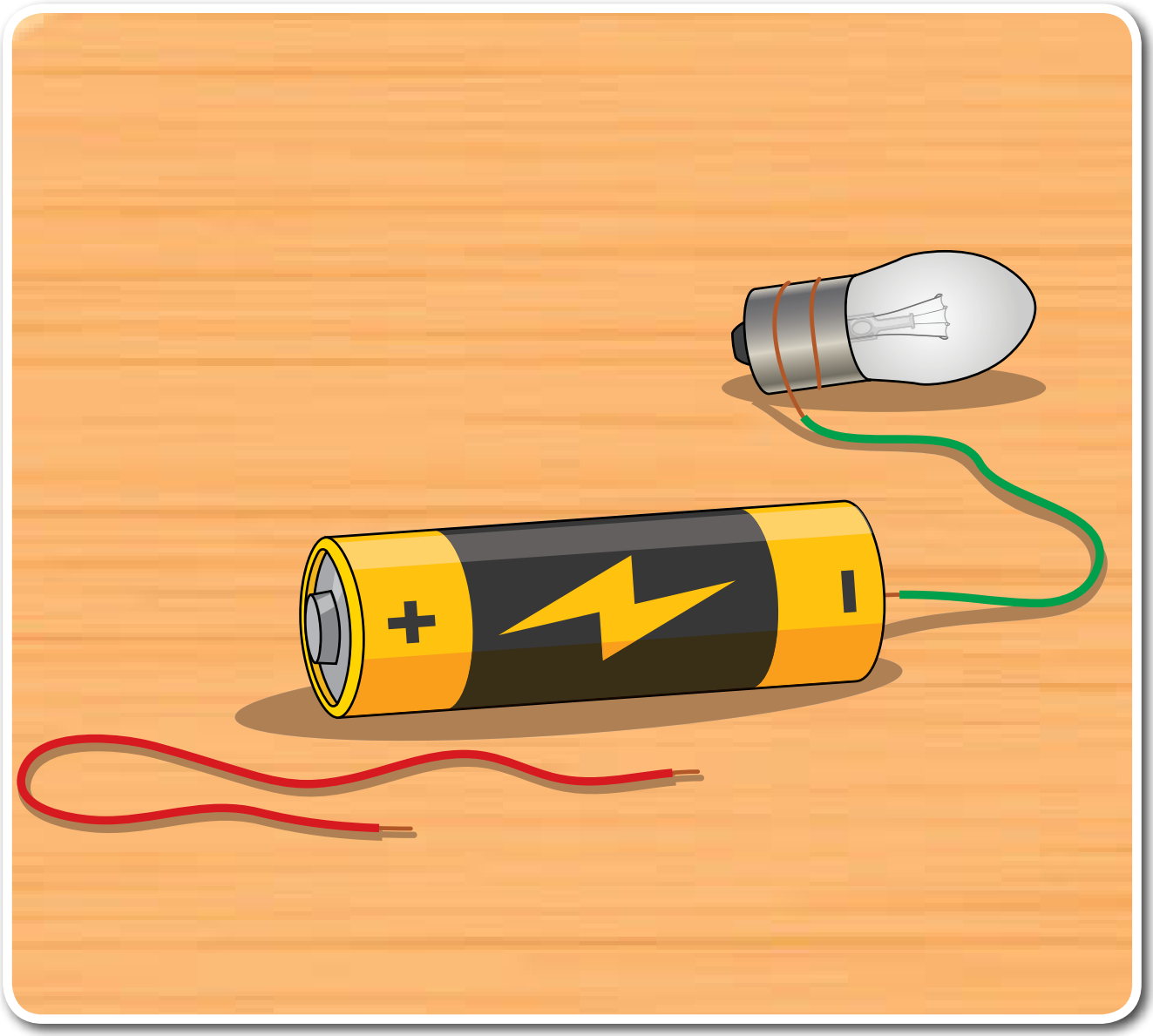
The electricity is still out at Eva's house. Mom says, "Let's build an electric circuit to help you understand more about how current electricity works."

Mom collects some wires, a battery, and a light bulb. By the light of a candle, they sit down at the kitchen table to do their project.



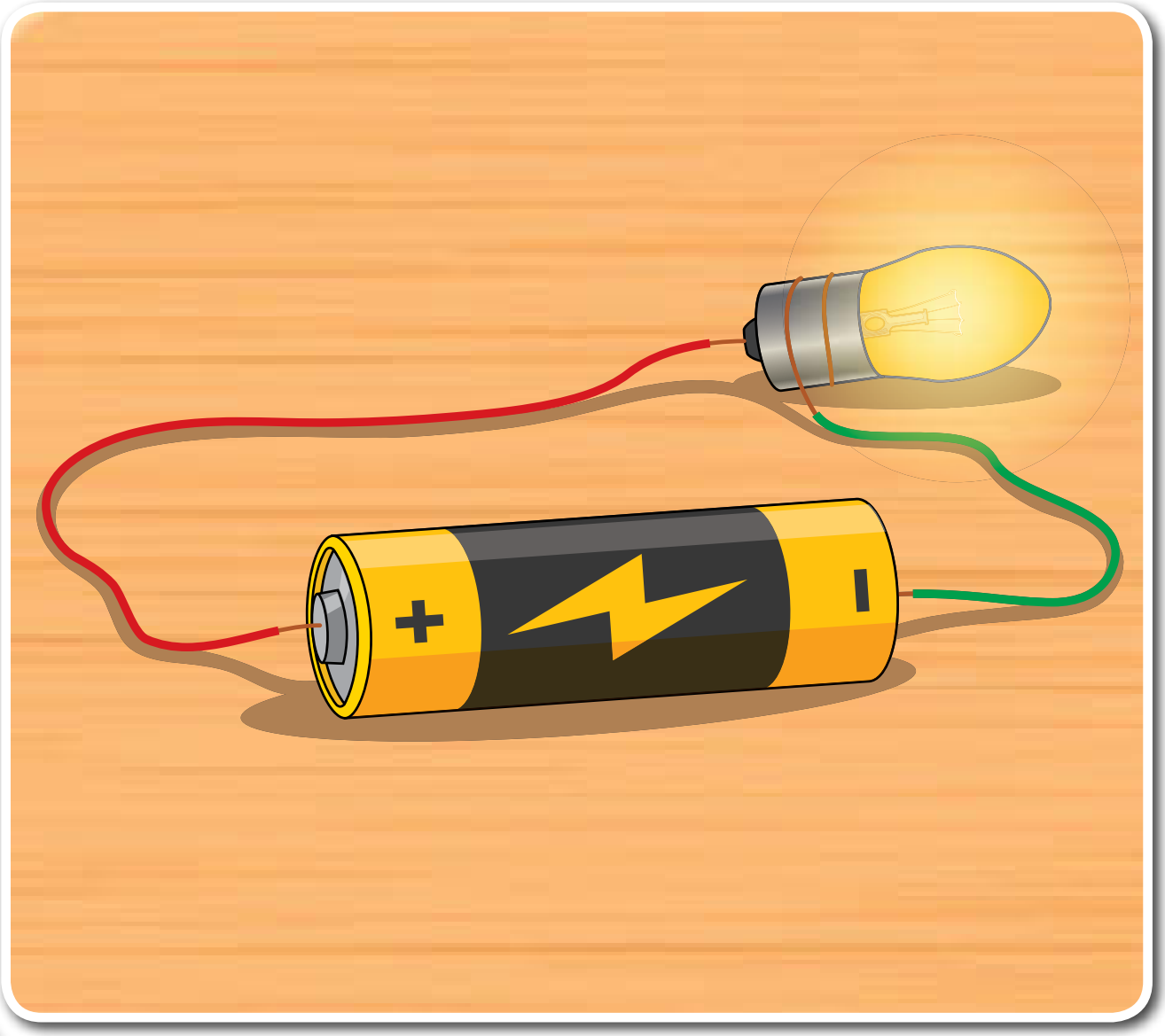
Eva knows that current electricity needs to exist through wires. And she knows that a battery can provide the electricity to light a bulb. Mom wants to show Eva another detail about what a current is.

She shows Eva how to connect a wire to the bulb and to one end of the battery. But nothing happens.



But when Mom attaches another wire to the battery then touches it to the end of the bulb, the bulb lights up! Mom says, “Current electricity has to exist in a loop. The loop is called a circuit. When you close the loop, you complete the circuit.

“When the circuit is complete, current electricity exists from one end of the battery, in the light bulb, and also at the other end of the battery. A loop!”



“Now think about a light switch,” Mom says. “When you flip a switch off and on, you are *switching* the circuit from an open loop to a closed loop.”

A switch that is ON completes the loop in a circuit. Current electricity can exist.

A switch that is OFF creates a break in the loop. Current electricity cannot exist.

Eva is curious. Why does current electricity stay inside wires and not go out into walls and all the parts of appliances. Mom explains that current electricity can only exist in certain materials. Electricity in houses often is in copper wires. And these wires are wrapped in materials that keep the electricity safely inside the wires.

SAFETY

Because electricity can exist in water, it is dangerous to use electrical appliances near water. Do not go near water with anything that is in contact with electric cords or devices.

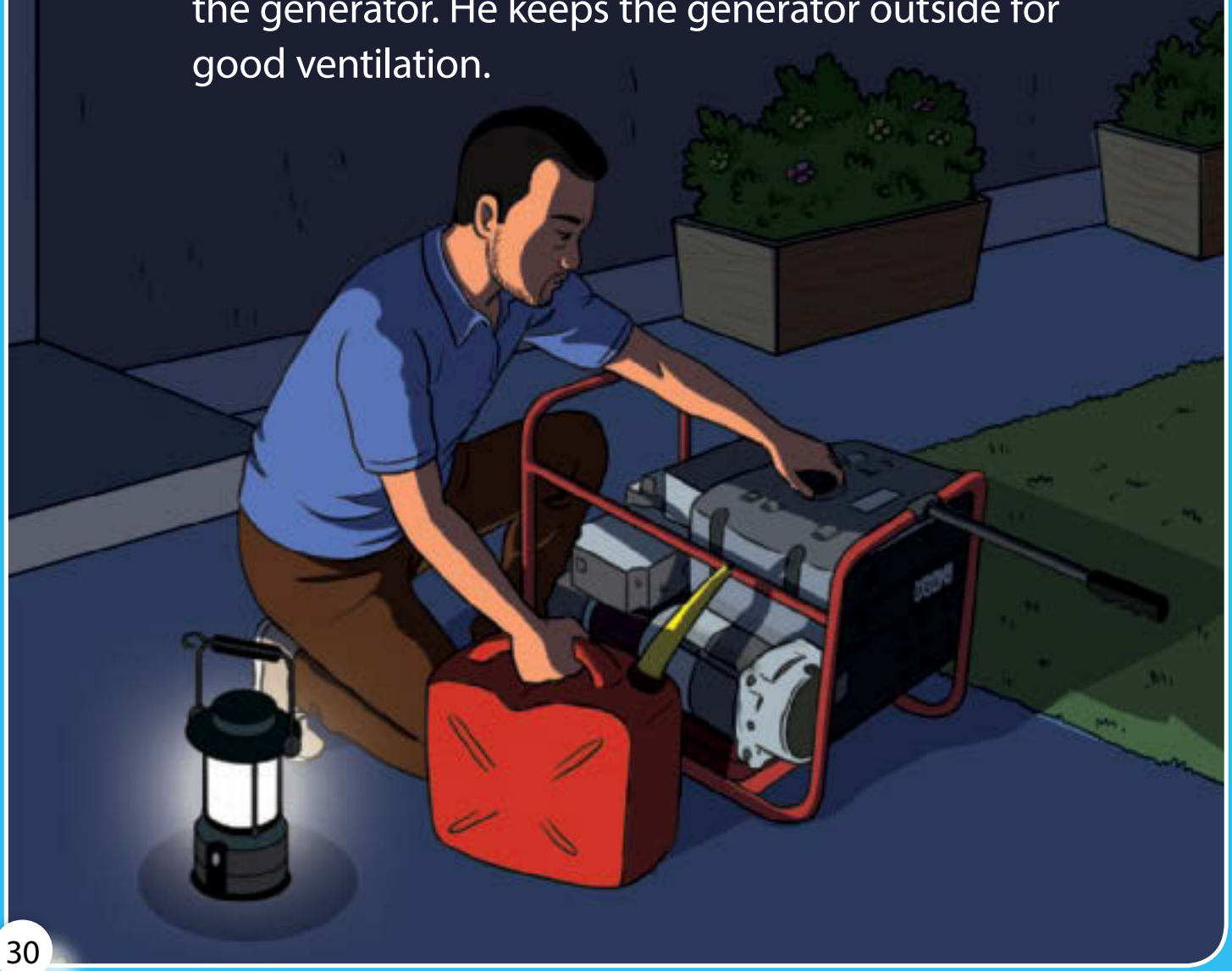
Electric current can exist within a copper wire. It can not exist in some other materials. Glass, plastic, wood, and rubber do not conduct electricity. These materials are used to make the parts of electrical appliances that are safe to touch.

CHAPTER 6

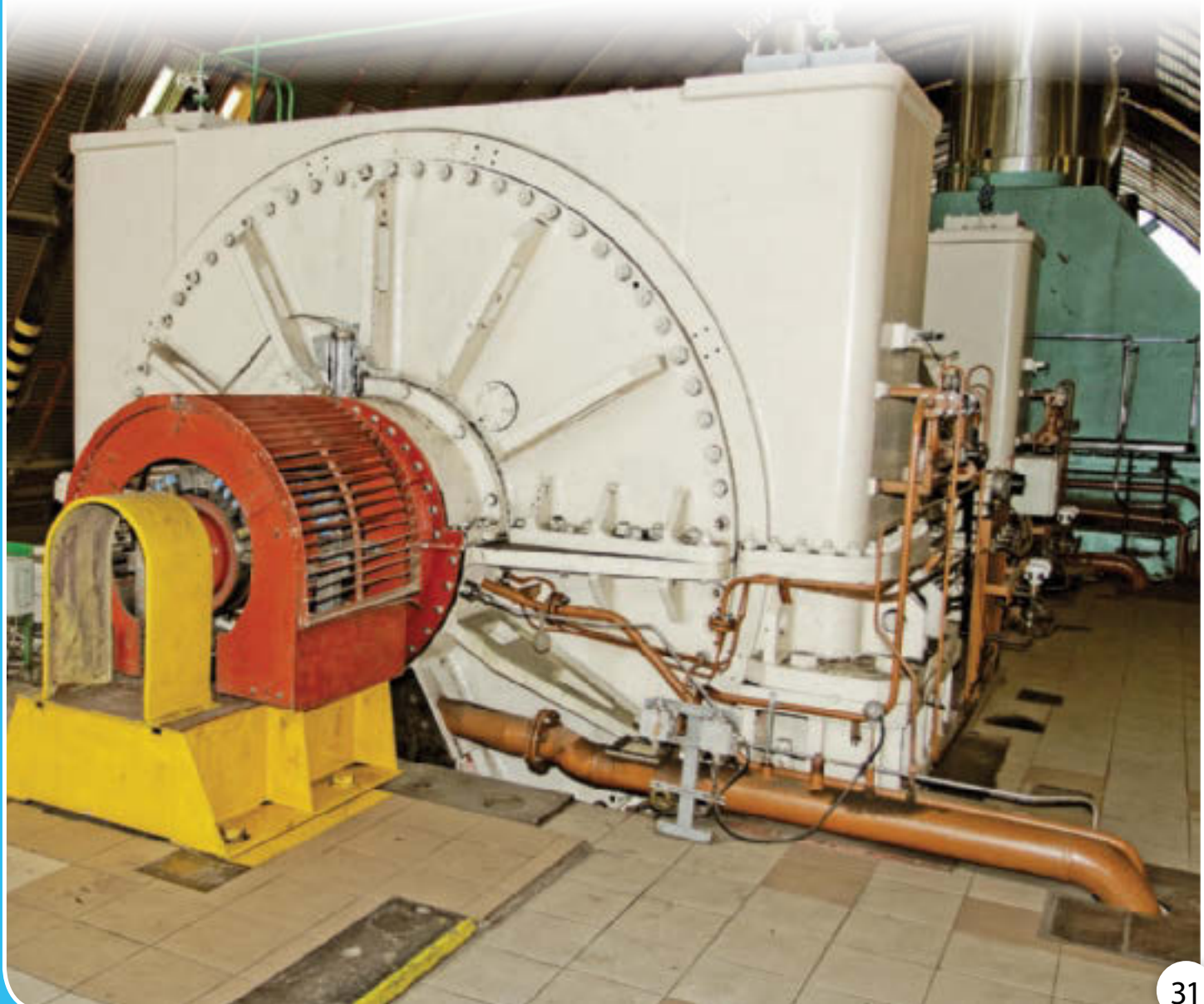
Magnets and Electricity

It looks like the electricity is going to be out all night at Eva's house. Dad is concerned about the refrigerator. Without electricity, the refrigerator cannot keep the family's food cold. The food might spoil.

Dad has an idea. The family has a generator that they use when they are camping. The generator burns gasoline to make a motor run. The motor produces electricity! Dad plugs the refrigerator into the generator. He keeps the generator outside for good ventilation.



“Remember the power lines that bring electricity to our house?” Dad asks Eva. “They come from a power plant that produces electricity. The power plant uses great big generators like this one to make electricity.”



"You have already used a little version of a generator tonight, and you didn't even know it," Dad says with a smile. "It was the hand-crank flashlight."

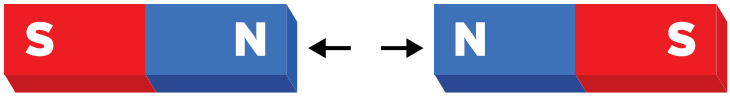
Eva learns more. Turning the hand crank on the flashlight rotates parts inside made of magnets and coiled wire. Moving coiled wire close to a magnet causes a current in the wire. This flashlight is powered by cranking a handle. Now Eva understands why the light in that flashlight faded soon after she stopped cranking the handle.

The generator works in a similar way. Parts inside made of magnets and coiled wire spin. The rotation produces electric current in the wire.

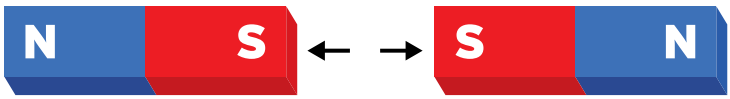
Electric motors and generators both need magnets to work.

Remember that magnets produce invisible pushes and pulls.

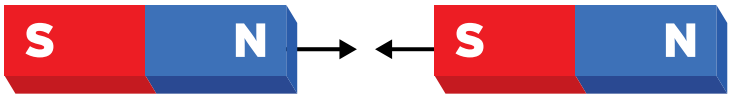
Two north poles push each other.

a) 

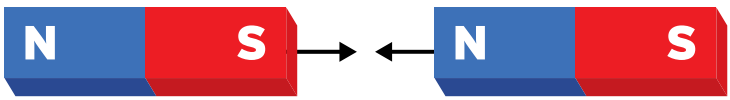
Two south poles push each other.

b) 

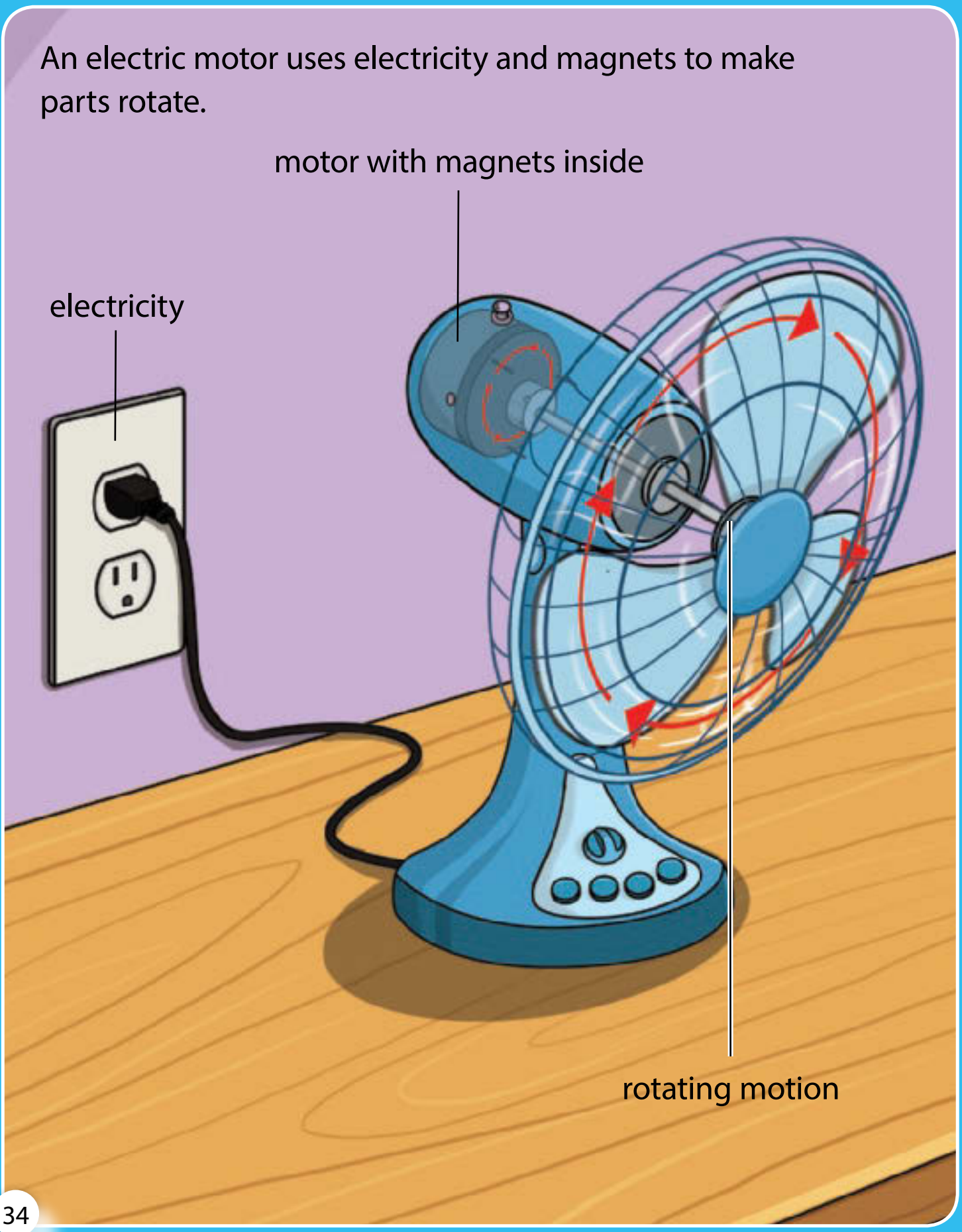
A north pole and a south pole pull each other.

c) 

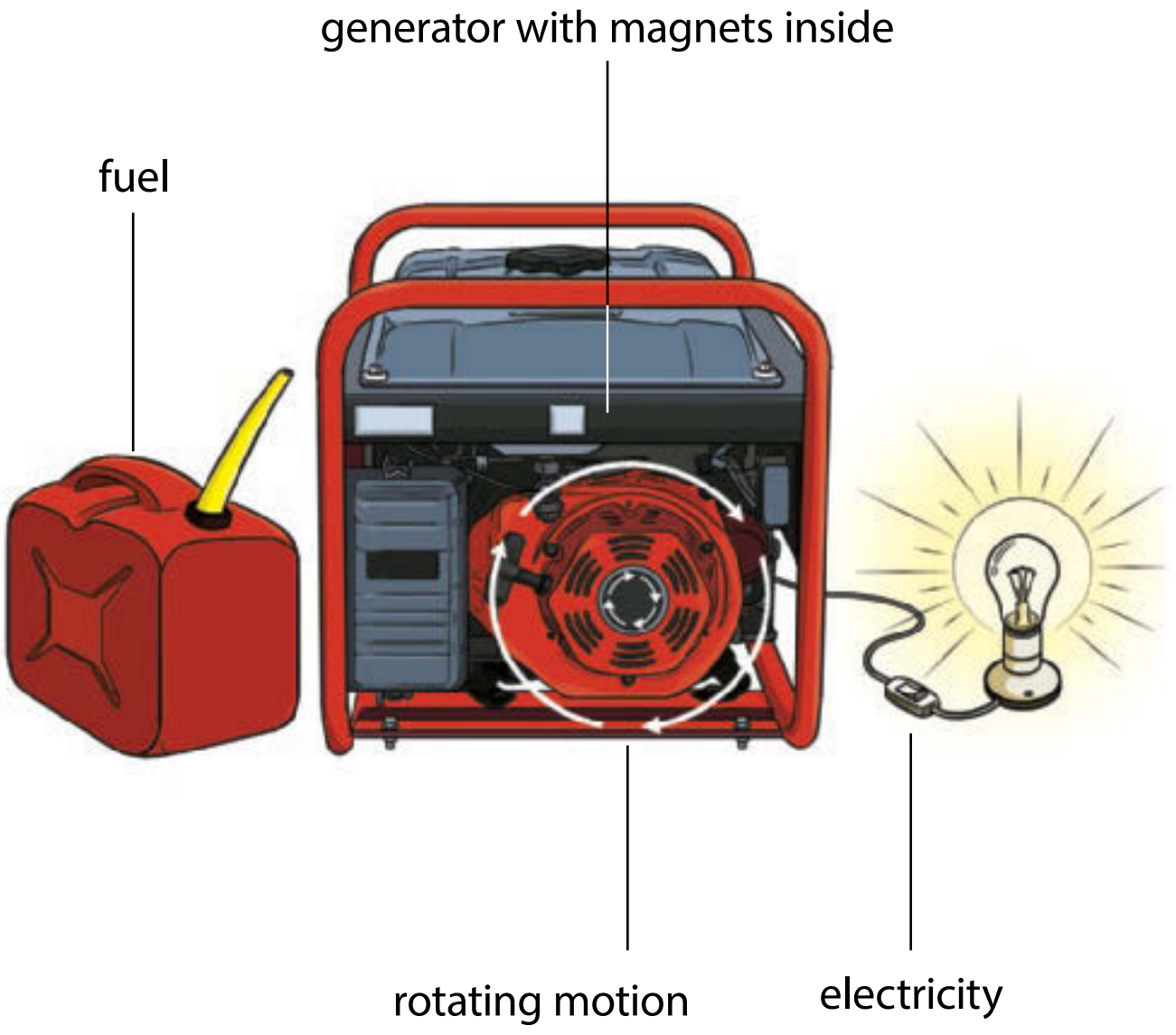
A south pole and a north pole pull each other.

d) 

An electric motor uses electricity and magnets to make parts rotate.



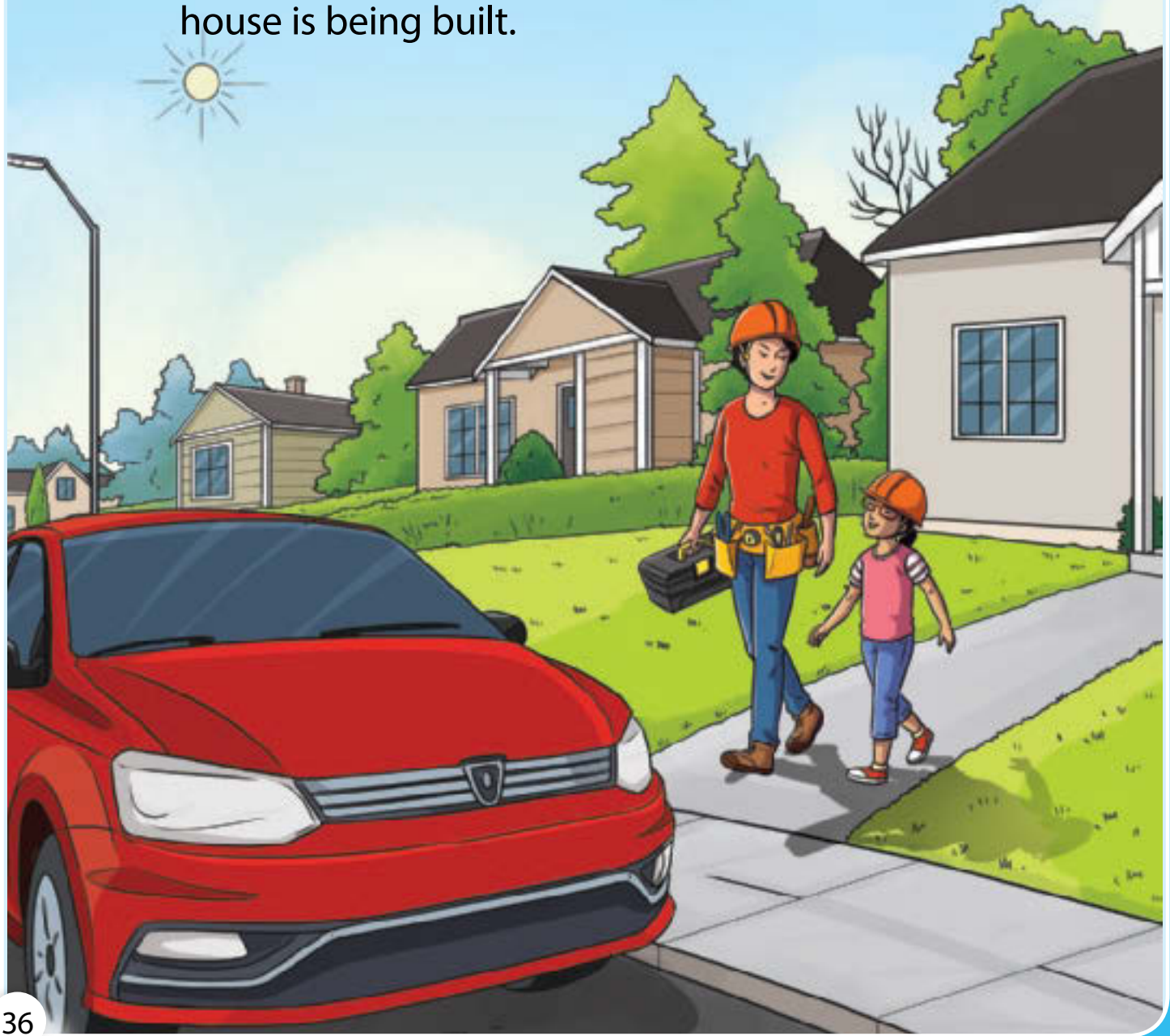
A generator uses magnets and rotating parts to make electricity.



Science in Action

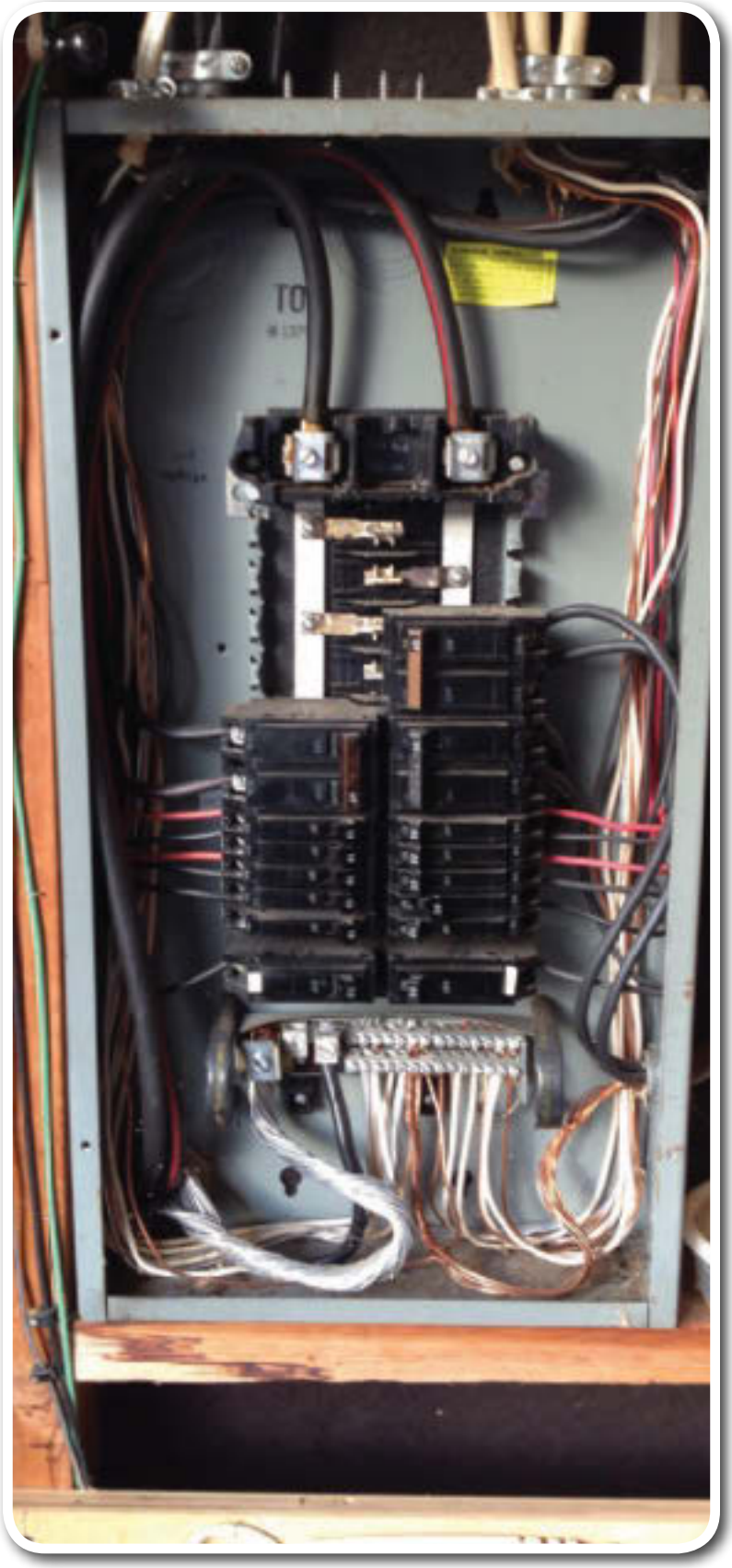
A Day with an Electrician

The electricity at Eva's house came back on during the night. This morning she is excited because she gets to go to work with Mom for a while. Mom is an electrician. She is going to show Eva how she puts electric wires inside walls of a house while the house is being built.



Mom begins by showing Eva the new house's electric panel. This is the place where electricity from power lines enters the house. Mom needs to attach wires to this box and run them to all the home's electrical wall sockets and ceiling light fixtures.

Before Mom attaches wires to the panel, she must make sure the electricity coming into the panel is turned off.



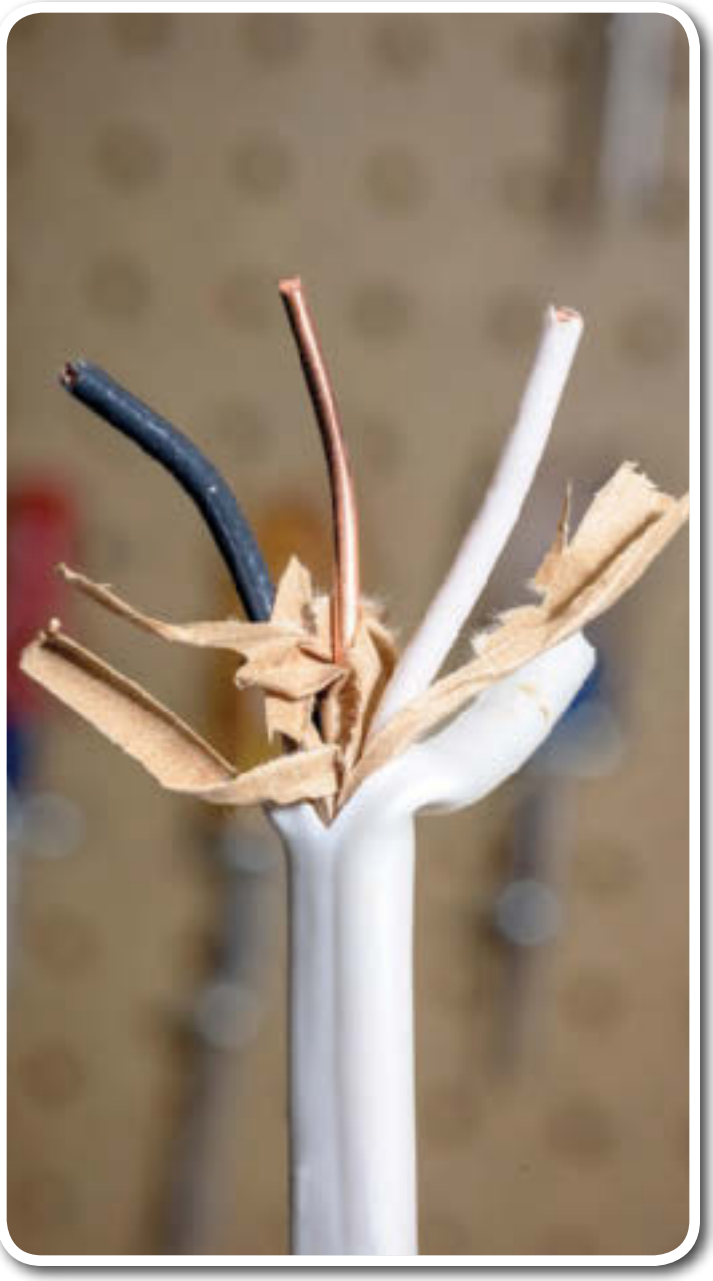
SAFETY

Never touch an electrical panel. Only adults should operate the switches in these boxes.

Construction of a wall begins with a wood or metal frame. Eva's mom does her work while the wall frames are still exposed. She drills holes to make room for the wires to run through. She pulls wires all over the house, to wherever people might need to plug things in.

Mom shows Eva how she installs an electrical socket. She attaches a box that holds the socket to the wall frame. Then she shows Eva the wire's white plastic coating. Inside are three wires wrapped together.

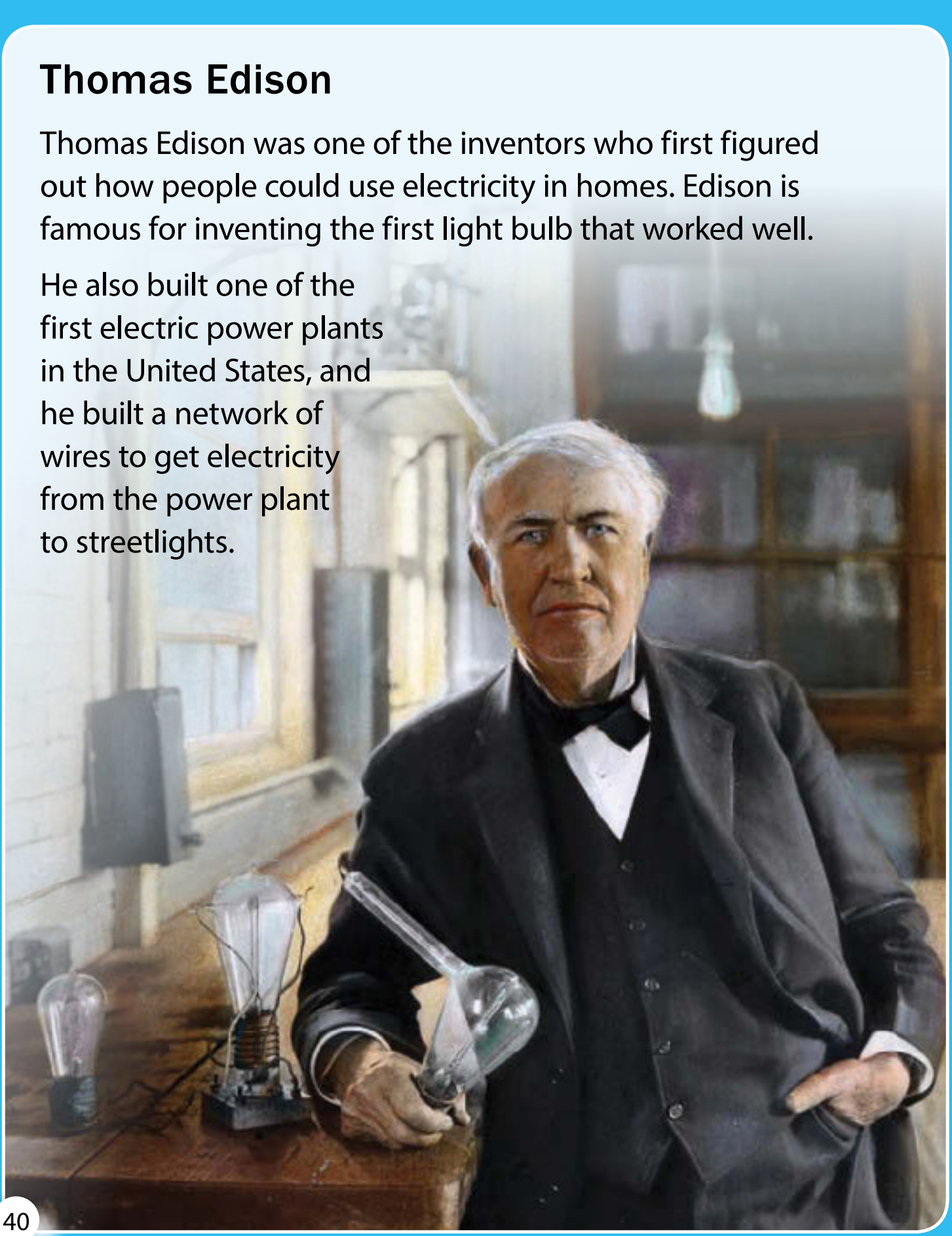
Mom separates those wires and strips the plastic coating off of them. She exposes shiny copper wire that is on the inside. She attaches the bare copper ends to the socket with screws. Mom is making sure that the wiring in the house has loops so current electricity can exist. Later, workers will add flat surfaces to the walls so that only the socket is visible. All the wiring will be hidden within the walls.



Thomas Edison

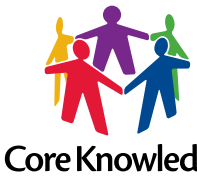
Thomas Edison was one of the inventors who first figured out how people could use electricity in homes. Edison is famous for inventing the first light bulb that worked well.

He also built one of the first electric power plants in the United States, and he built a network of wires to get electricity from the power plant to streetlights.



One of Thomas Edison's most important inventions, though, was much simpler. He knew that for houses to have electricity in them, the wire needed to be safe and keep all the electricity inside it. The wrapping around the wire had to be waterproof and fireproof.

Edison patented insulated electrical wire. This was copper wire wrapped in braided cotton and a rubber coating. The coating on electrical wires allows cords to be touched without risk of electrical shock. Safety first!



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