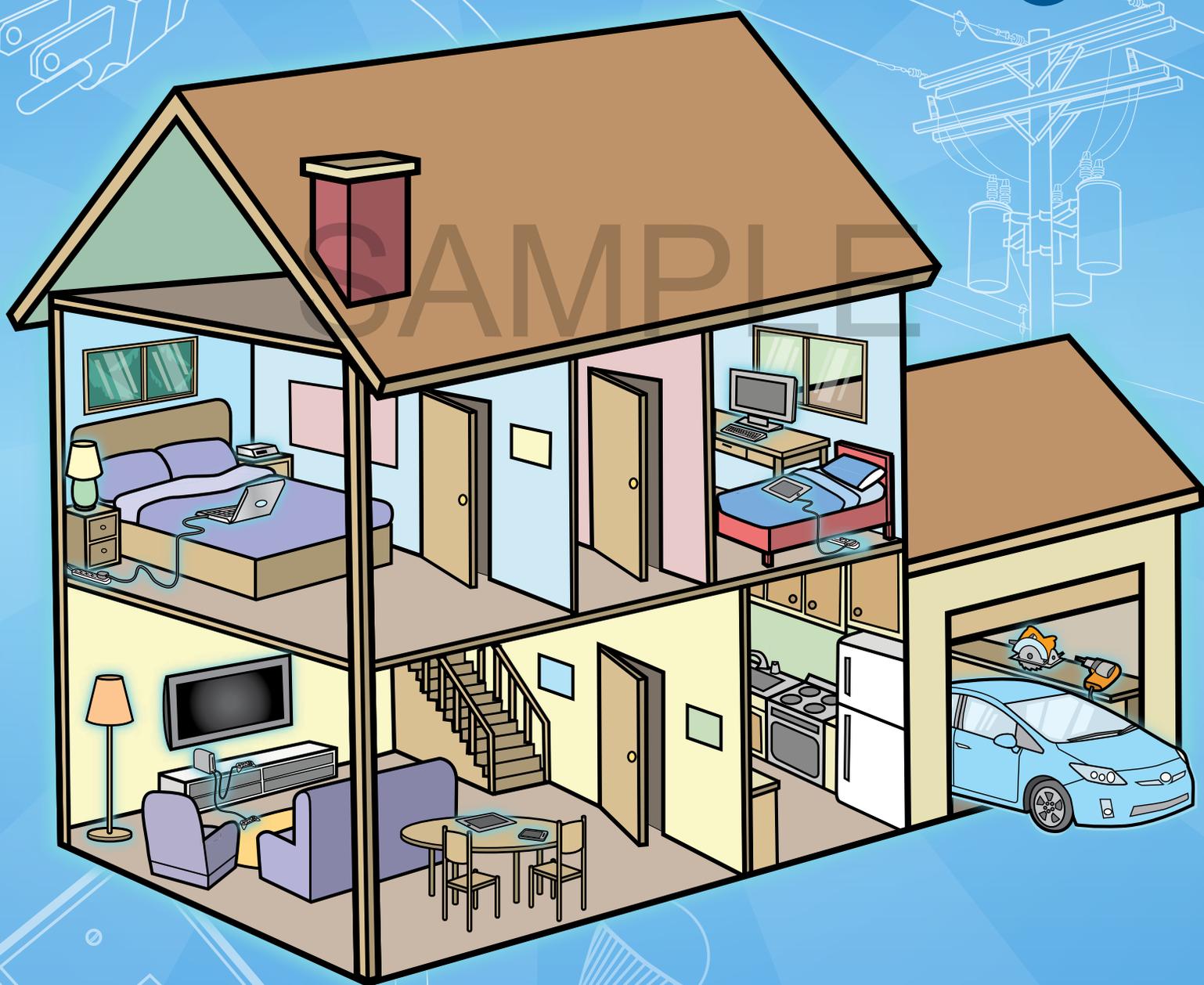


# Ecstatic about *Electricity*



This book belongs to:



Discover the power of electricity, and how to save it too!

**Electricity Fun Facts ..... 3**

Electricity is amazing!

**Electricity Is Everywhere ..... 4**

Electricity is all around us, and we use it everyday; at home, at school, and at work.

**Sources of Electricity ..... 6**

Where does our electricity come from? Get the facts!

**Electricity Basics ..... 8**

Want to know how electricity works? There's a lot to learn.

**Measuring Electricity ..... 9**

Your electric meter measures how much electricity you use. Find out how!

**Electricity in History ..... 10**

Meet some of history's most important inventors.

**It's Electric! ..... 12**

Can you identify all the things that use electricity in your home?

**Electricity Safety ..... 14**

Learn how to be safe around electricity—it's important!

**How Electricity Gets to You ..... 16**

How does electricity get to your home? Play this fun board game and find out!

**Saving Electricity in the Home ..... 18**

Saving electricity also means saving money!

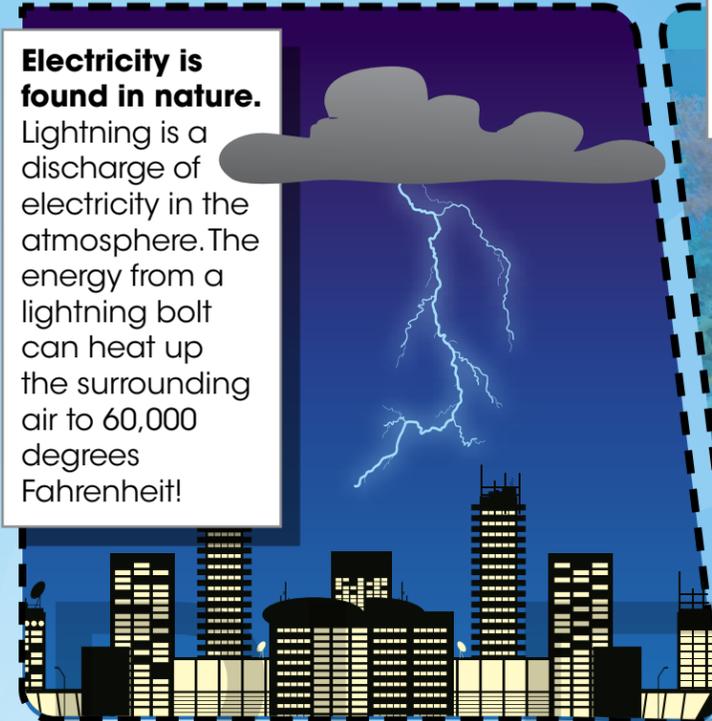
**Have Fun Learning about Electricity ..... 20**

Try these extra energy-saving activities!

# ELECTRICITY FUN FACTS

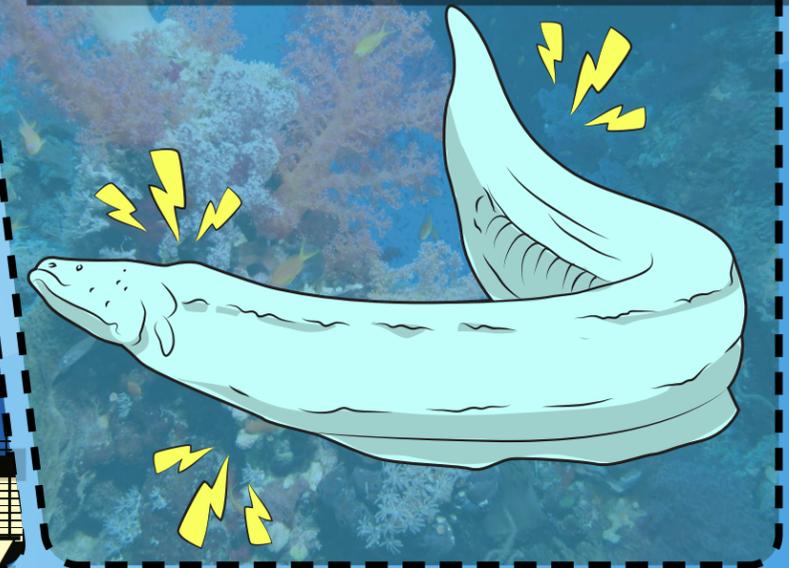
**Electricity is found in nature.**

Lightning is a discharge of electricity in the atmosphere. The energy from a lightning bolt can heat up the surrounding air to 60,000 degrees Fahrenheit!



**Electric eels are shocking!**

Electric eels can produce strong electric shocks of around 500 volts for both self-defense and hunting.

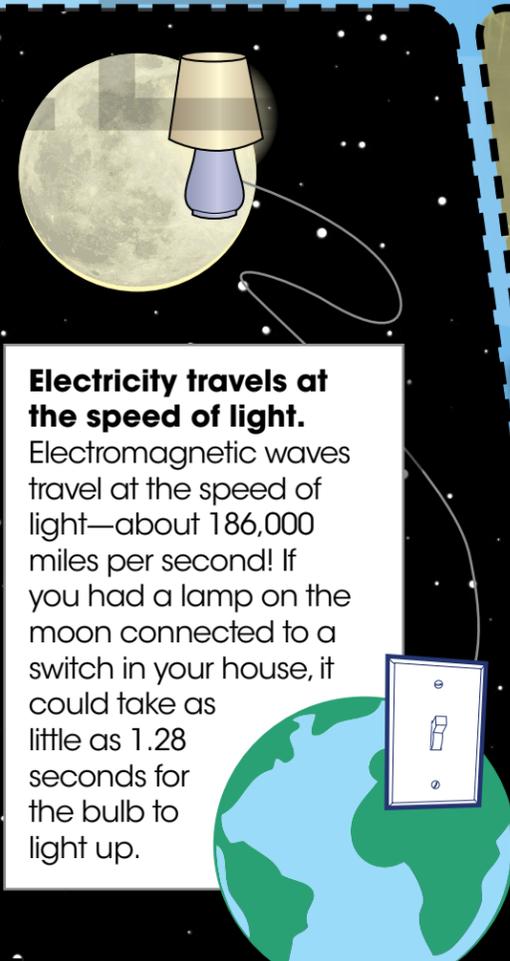


**The Statue of Liberty** was the first lighthouse to use electric lights (in 1886).

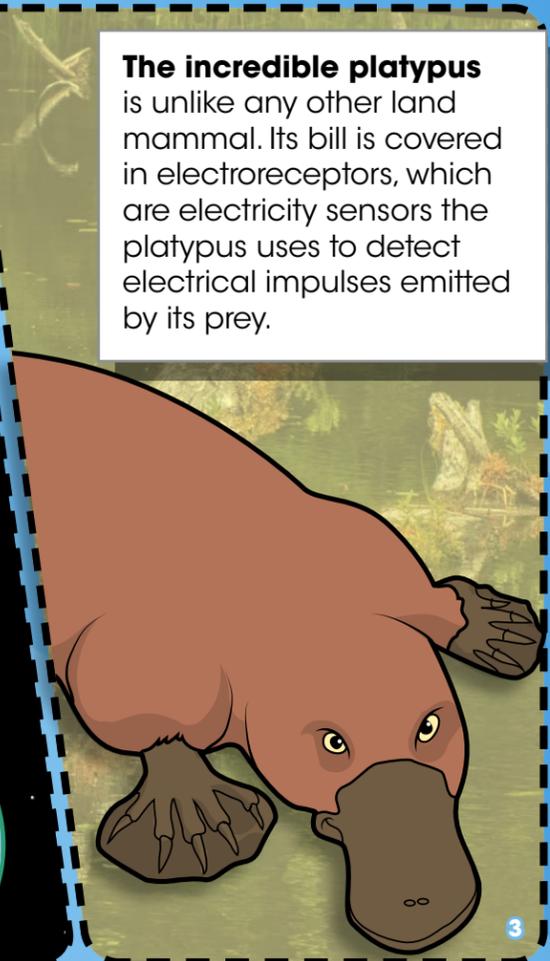


**Electricity travels at the speed of light.**

Electromagnetic waves travel at the speed of light—about 186,000 miles per second! If you had a lamp on the moon connected to a switch in your house, it could take as little as 1.28 seconds for the bulb to light up.



**The incredible platypus** is unlike any other land mammal. Its bill is covered in electroreceptors, which are electricity sensors the platypus uses to detect electrical impulses emitted by its prey.



# Electricity Is Everywhere!

We use electricity every day in homes, workplaces, and schools, as well as for manufacturing and food production.

## Buildings

Electricity is especially important in tall buildings. Imagine climbing the stairs all the way to the top—that would take a while! Luckily there's another option: some really tall buildings have elevators that use electricity to travel up to 1,000 feet per minute. Now, that's quick!



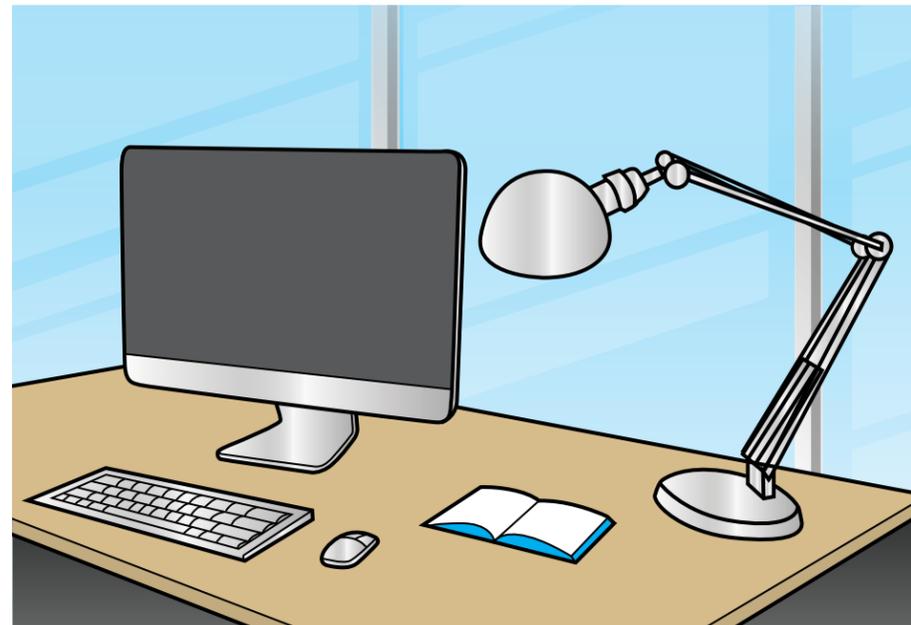
## Homes

We use electricity in many ways in our homes. It gives us light and entertainment, and keeps us cool in the summer. Kitchen appliances like refrigerators, coffee makers, dishwashers, microwaves, and toasters all need electricity to work. And don't forget TVs, phones, and computers—these gadgets use electricity too. Life would be pretty inconvenient without electricity!



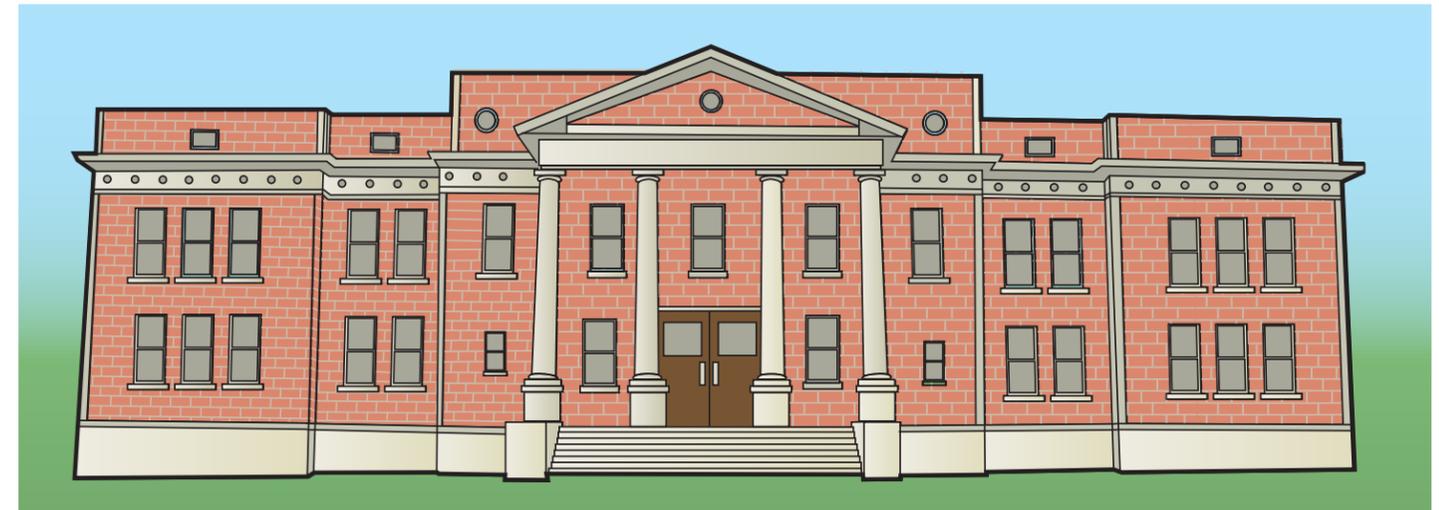
## Workplaces

Almost all jobs require the use of electricity. Offices use electricity to power lights, computers, and printers. Other jobs, such as construction work, use electricity to power machines like wood saws or jackhammers. Hospitals require electricity to run medical equipment. Even farmers use electric machinery to help them tend to their crops and animals!



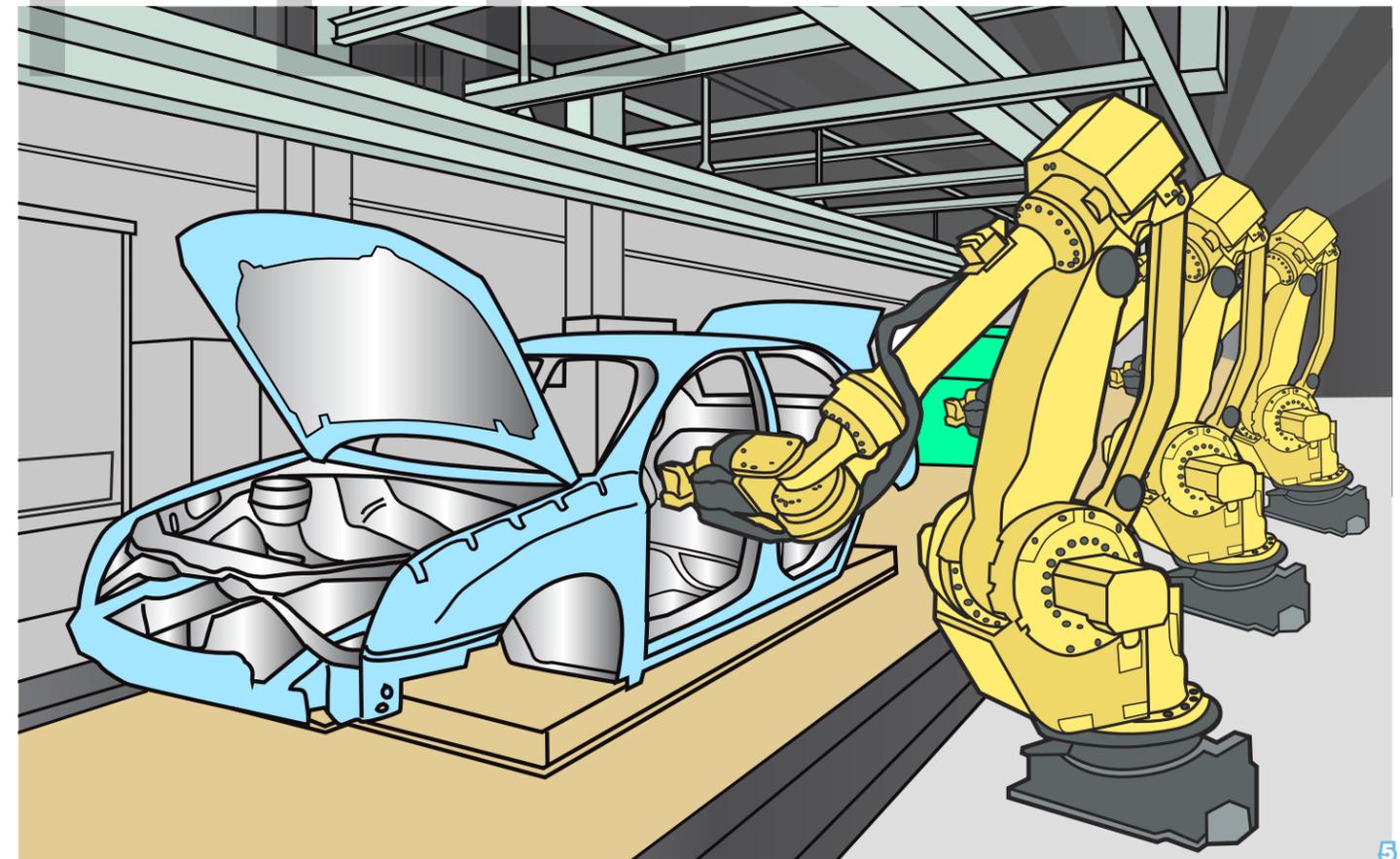
## Schools

Kids and teachers use electricity in school in many of the same ways they use it at home. For a comfortable learning environment, schools need lighting, cooling, and computers—and don't forget the cafeteria!



## Manufacturing

Making the products we use every day requires electricity too. It is necessary in the production of things as big as cars, trucks, and boats, or to make things as small as pens, pencils, and paperclips. Electricity is used to make finished products and raw materials like plastic and paper. Using less of these things is a great way to save electricity. Remember to always use both sides of a piece of paper, and try not to throw things out that can be used again!



# Sources of Electricity

Where does the electricity we use every day come from? It comes from a variety of sources. Some comes from nonrenewable fuels such as coal and natural gas, and some comes from renewable sources such as the sun, wind, water, and the heat from within the Earth.

## Nonrenewable Energy Sources

A nonrenewable energy source cannot be replaced. In other words, when it's gone, it's gone! Such nonrenewable resources are naturally formed and taken from the earth, but are limited in supply and will eventually run out. The most commonly used nonrenewable resources—also known as fossil fuels—are coal, natural gas, and petroleum.



### Coal

Coal looks like a shiny black rock and is used to generate a lot of the electricity we rely on every day! Most of the coal we use began to form at least 300 million years ago (long before the dinosaurs existed!), when vast forests and swamps covered the Earth. The formation of coal begins with the layering of plant remains in swampy, humid environments. As plants die, their remains sink, accumulating layer on top of layer, eventually forming a moist, dense material called peat. Over time the peat is compressed and the liquids are squeezed out. After many millions of years, the plant remains are transformed into coal.



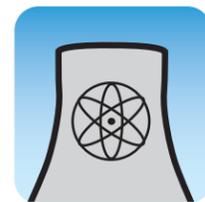
### Natural Gas

Natural gas is used in many homes for heating and cooking. Most natural gas forms from the burial and decay of tiny ancient marine animals over many millions of years. As the marine animals die they sink to the sea floor and are covered by layers of sediment and more tiny animals. Over long periods of time, and with added heat and pressure, natural gas is formed and stored within rock. Natural gas is extracted from pockets deep within the Earth.



### Petroleum

Like coal and natural gas, petroleum is formed over millions of years from organic material that lived long ago in marine environments. Petroleum (also called oil) is a dark-colored liquid found in reservoirs deep underground. It is pumped to the surface by wells drilled through layers of earth and rock. Petroleum is used to make gasoline, jet fuel, diesel fuel, and many other products.

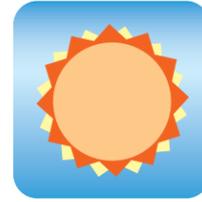


### Nuclear

Everything around us is made up of tiny particles called atoms. These atoms are made up of even smaller particles, called subatomic particles, which orbit the center of the atom—the nucleus—in much the same way planets orbit the sun. Very strong bonds hold the nucleus together. When these bonds are broken, using a process called nuclear fission, energy is released that can be used to make electricity! To do this, many nuclear power plants use an element called uranium. Uranium is a common metal found in rocks worldwide, but a rare type of uranium called U-235 is needed. Uranium-235 is a nonrenewable resource.

## Renewable Energy Sources

Renewable energy sources are naturally occurring, replenished, and will not run out. These sources harness the energy from the sun, wind, water, and the heat of the Earth. Solar energy, wind energy, hydropower, and geothermal energy are all examples of renewable energy.



### Solar

The sun provides energy for all living things on Earth. Plants use the sun to make food, which keeps their leaves looking green. We can also use the sun's energy to generate electricity. This type of energy is called solar energy.



### Wind

The energy of moving air can be used as an electricity source. As the wind turns giant blades on a machine called a wind turbine, electricity is created!



### Water

Electricity generated by flowing water is called hydroelectric power. Flowing water turns a turbine, which is connected to a generator to make electricity. Hydropower is mostly produced by dams, waterfalls, and areas that have a strong, quickly moving current.



### Earth's Heat

Energy generated from the heat of the Earth is called geothermal energy ("geo" means Earth, and "thermal" means heat). The heat stored deep inside the Earth is used to generate steam in order to make electricity. Geothermal energy can even be used to warm your house!



# Electricity Basics

We know we use a lot of it, but what is electricity? Atoms, subatomic particles, and electric currents—oh, wow! Read on to learn some basic facts about electricity that everyone should know!

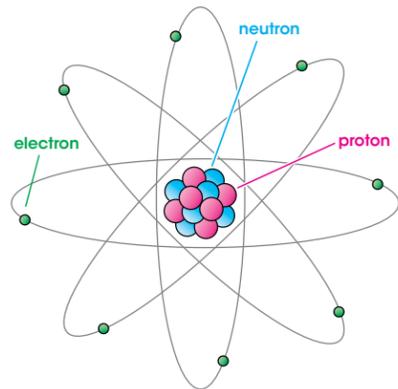
## What Is Electricity?

To really understand electricity, you need to know about atoms first. Atoms are tiny particles (way too small to see with your eye—in fact, millions could fit on the tip of a pin!) that make up everything around us. Touch your desk or wave your hand through the air—everything is made of atoms, even you!

Atoms are made up of even smaller particles—protons, neutrons, and electrons—known as subatomic particles.

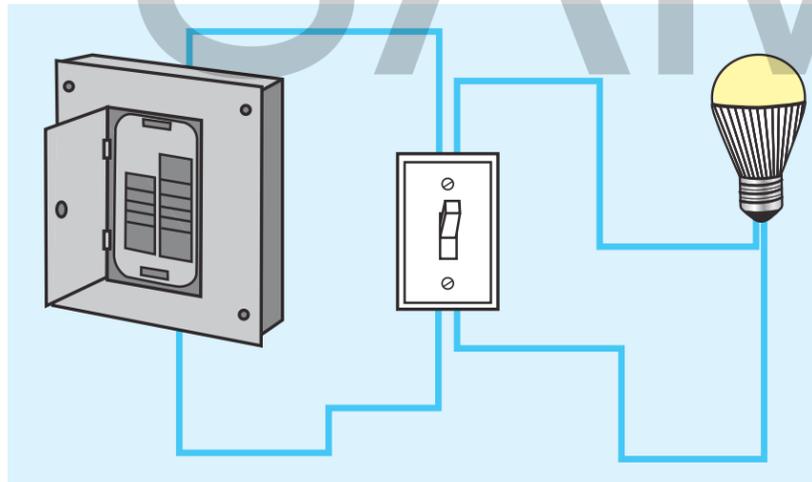
Protons are positively charged particles that stick with the neutrons (which have no charge) in the center of the atom, called the nucleus. The electrons, which are negatively charged, spin very quickly around the nucleus.

Electrons can move from one atom to another, and when they move in the same direction, through a conductor, we call this an electric current. Electricity is created by the movement of electrons! Whew!



## Circuits

The word *circuit* means “circle.” Electricity can only move in a closed circuit. If a circuit is open, the electricity cannot flow. When we flip on a light switch, we close a circuit. The electricity flows from an electric wire, through the lightbulb, and back out another wire. When we flip the switch off, we open the circuit and no electricity flows to the light.

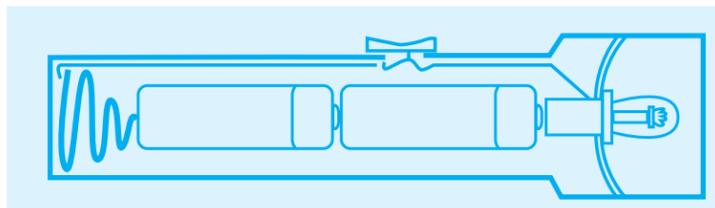


## Batteries

Batteries store electricity in a chemical form. Some are used once and discarded, such as the alkaline batteries used in flashlights and other portable devices. Other batteries are rechargeable and can be used many times, such as car batteries and lithium ion batteries used in cell phones, tablets, and laptops.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and

wristwatches, to battery banks the size of rooms that provide standby power for telephone exchanges and computer data centers.



# Measuring Electricity

Now that you know how electricity is generated, the next step is to measure how much you use. When you use electricity in your home, it first passes through an electric meter. The meter tells your electricity company how much electricity you use. Electricity costs money and the more you use the bigger the cost! The meter measures electricity usage in kilowatt-hours (kWh), or the amount of electricity used over a length of time. The average cost for power is \$0.10 per kilowatt-hour.

## Electric Meter

An electric meter can look complicated. But once you learn about the different parts, you will be able to read your home’s meter and help your family keep track of their electricity usage! A standard electricity meter has five dials:

Dial 1 measures 1s and the dial hand turns clockwise.

Dial 2 measures 10s and the dial hand turns counter-clockwise.

Dial 3 measures 100s and the dial hand turns clockwise.

Dial 4 measures 1,000s and the dial hand turns counter-clockwise.

Dial 5 measures 10,000s and the dial hand turns clockwise.

The electric meter is read from right to left (the opposite of how you read a book). If the dial is between two numbers, always record the smaller number.

In this example, the meter reads 57,434 kWh.

## Meter Reader Challenge!

Can you read these electric meters? How many kilowatt-hours did each family use this month? How much was their monthly bill if the average cost is \$0.10 per kWh?

### Family 1

First read this meter:

$$\begin{array}{r} \underline{\hspace{1cm}} \\ - \hspace{1cm} 44,600 \\ \hline \end{array} = \underline{\hspace{1cm}}$$

(This month's reading) - (last month's reading) = (kWh used)

$$\underline{\hspace{1cm}} \times \underline{\hspace{1cm}} .10 = \underline{\hspace{1cm}}$$

(kWh used) x (average cost) = (this month's bill)

### Family 2

First read this meter:

$$\begin{array}{r} \underline{\hspace{1cm}} \\ - \hspace{1cm} 71,531 \\ \hline \end{array} = \underline{\hspace{1cm}}$$

(This month's reading) - (last month's reading) = (kWh used)

$$\underline{\hspace{1cm}} \times \underline{\hspace{1cm}} .10 = \underline{\hspace{1cm}}$$

(kWh used) x (average cost) = (this month's bill)

### Family 3

First read this meter:

$$\begin{array}{r} \underline{\hspace{1cm}} \\ - \hspace{1cm} 62,736 \\ \hline \end{array} = \underline{\hspace{1cm}}$$

(This month's reading) - (last month's reading) = (kWh used)

$$\underline{\hspace{1cm}} \times \underline{\hspace{1cm}} .10 = \underline{\hspace{1cm}}$$

(kWh used) x (average cost) = (this month's bill)

## Think About It

Can you answer these questions about your electricity use? (Ask an adult for help!)

What is the name of the electric company your family uses to power your home?

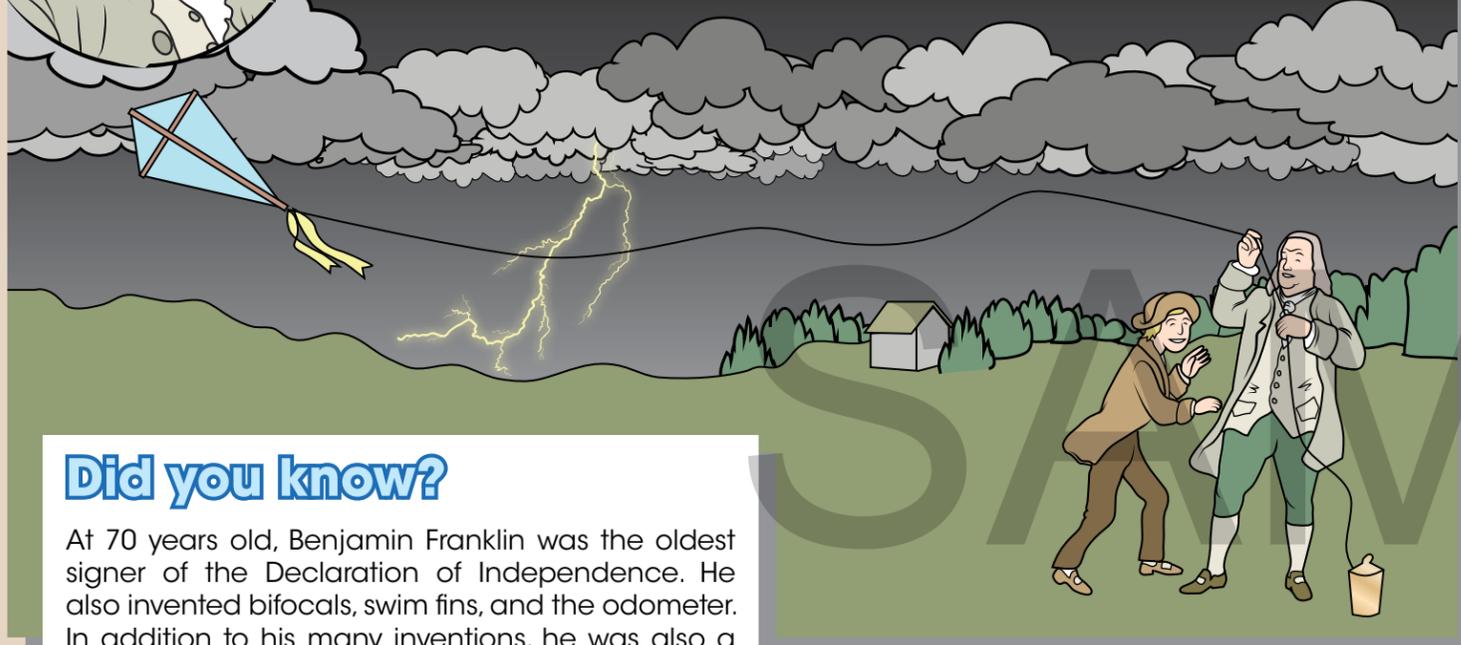
About how many kilowatt-hours did your family use this month?

# Electricity in History

Electricity wasn't always available. Before its invention, people used candlelight and kerosene or oil lamps to illuminate their homes at night. Many scientists, engineers, and inventors contributed greatly to our modern way of living.

## Benjamin Franklin

Benjamin Franklin, one of our country's Founding Fathers, lived in the 1700s and was a man of many talents. Through his experiments, Franklin proved that lightning is an electrical phenomenon. Along with his investigation of electricity, Franklin invented the lightning rod, which is still widely used today to protect homes and buildings from dangerous lightning strikes. Remember, if a storm is coming, it's best to find shelter right away!

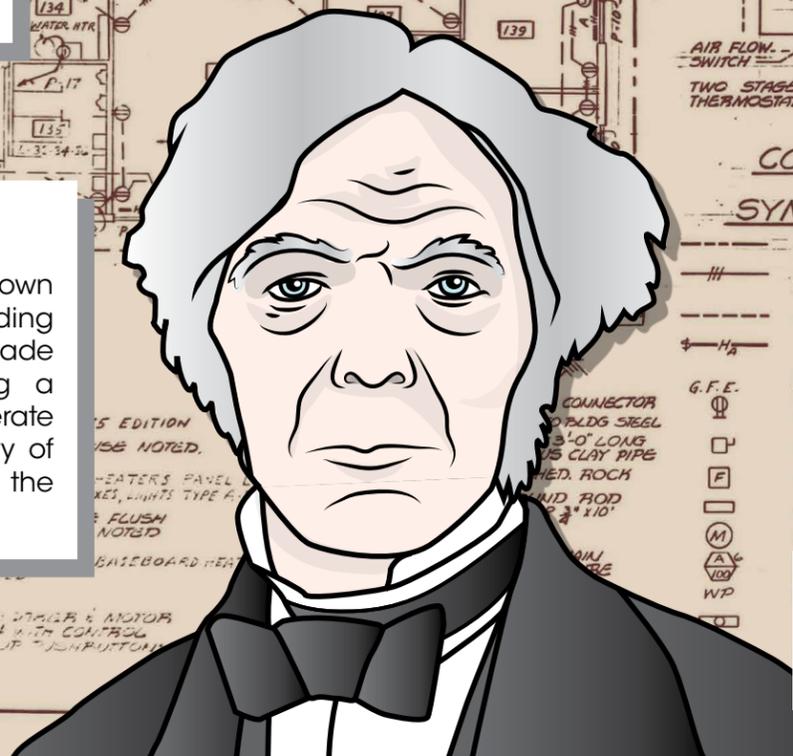


### Did you know?

At 70 years old, Benjamin Franklin was the oldest signer of the Declaration of Independence. He also invented bifocals, swim fins, and the odometer. In addition to his many inventions, he was also a talented musician and loved to play chess!

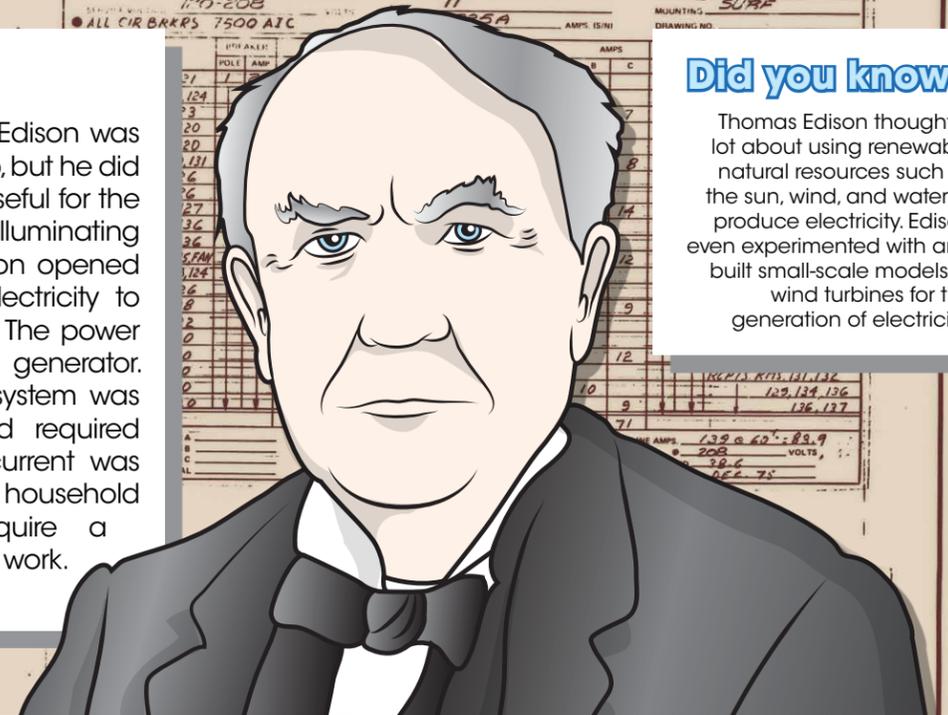
## Michael Faraday

Michael Faraday, an English chemist and physicist, is known for his many contributions to our modern understanding of electricity and magnetism. In 1831, Faraday made a monumental discovery—he found that moving a magnet inside a wire coil could be used to generate an electric current and electricity. With this discovery of electromagnetic induction, Faraday went on to build the first transformer, generator, and electric motor!



## Thomas Edison

Contrary to popular belief, Thomas Edison was not really the inventor of the lightbulb, but he did make the lightbulb available and useful for the general public. In 1882, the Edison Illuminating Company's Pearl Street Power Station opened in New York City and provided electricity to homes and businesses in the area. The power station used a direct current (DC) generator. But because Tesla's AC electricity system was cheaper, could travel farther, and required fewer power plants, Edison's DC current was largely phased out. However, most household appliances and electronics require a conversion from AC to DC current to work. Thanks, Thomas!

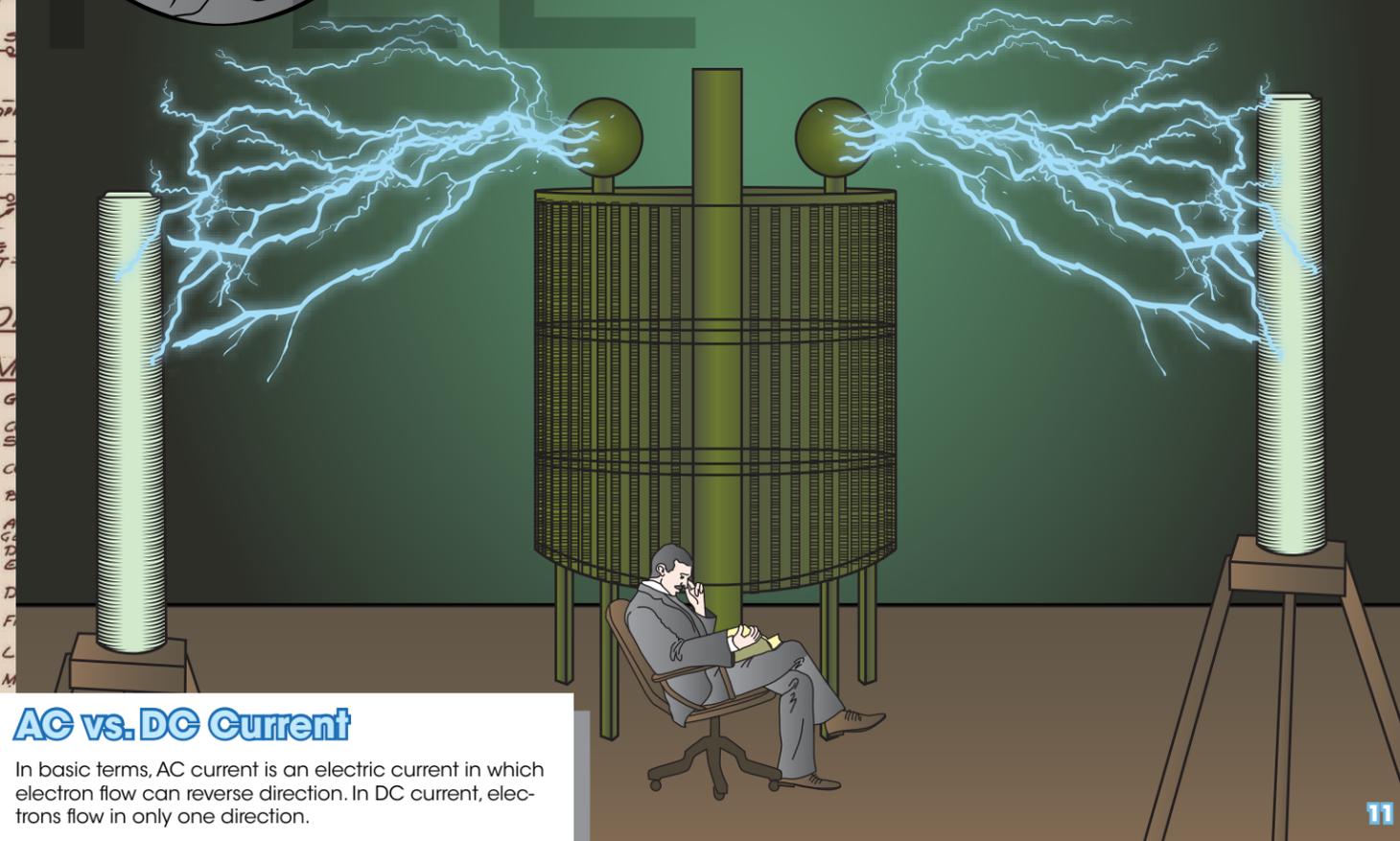


### Did you know?

Thomas Edison thought a lot about using renewable natural resources such as the sun, wind, and water to produce electricity. Edison even experimented with and built small-scale models of wind turbines for the generation of electricity!

## Nikola Tesla

Nikola Tesla, a Serbian-American engineer and inventor, is to thank for much of the energy technology we use today. His innovations provided the groundwork for modern radios, TVs, and even smartphones. After moving to the United States in 1884 to work for Thomas Edison, Tesla decided to pursue his own work on the alternating current, or AC current, the foundation for the electricity system we use today. Tesla developed many other inventions too. By harnessing the power of flowing water, in 1896 Tesla designed and built a hydroelectric plant to power homes in Buffalo, New York. Impressive!



### AC vs. DC Current

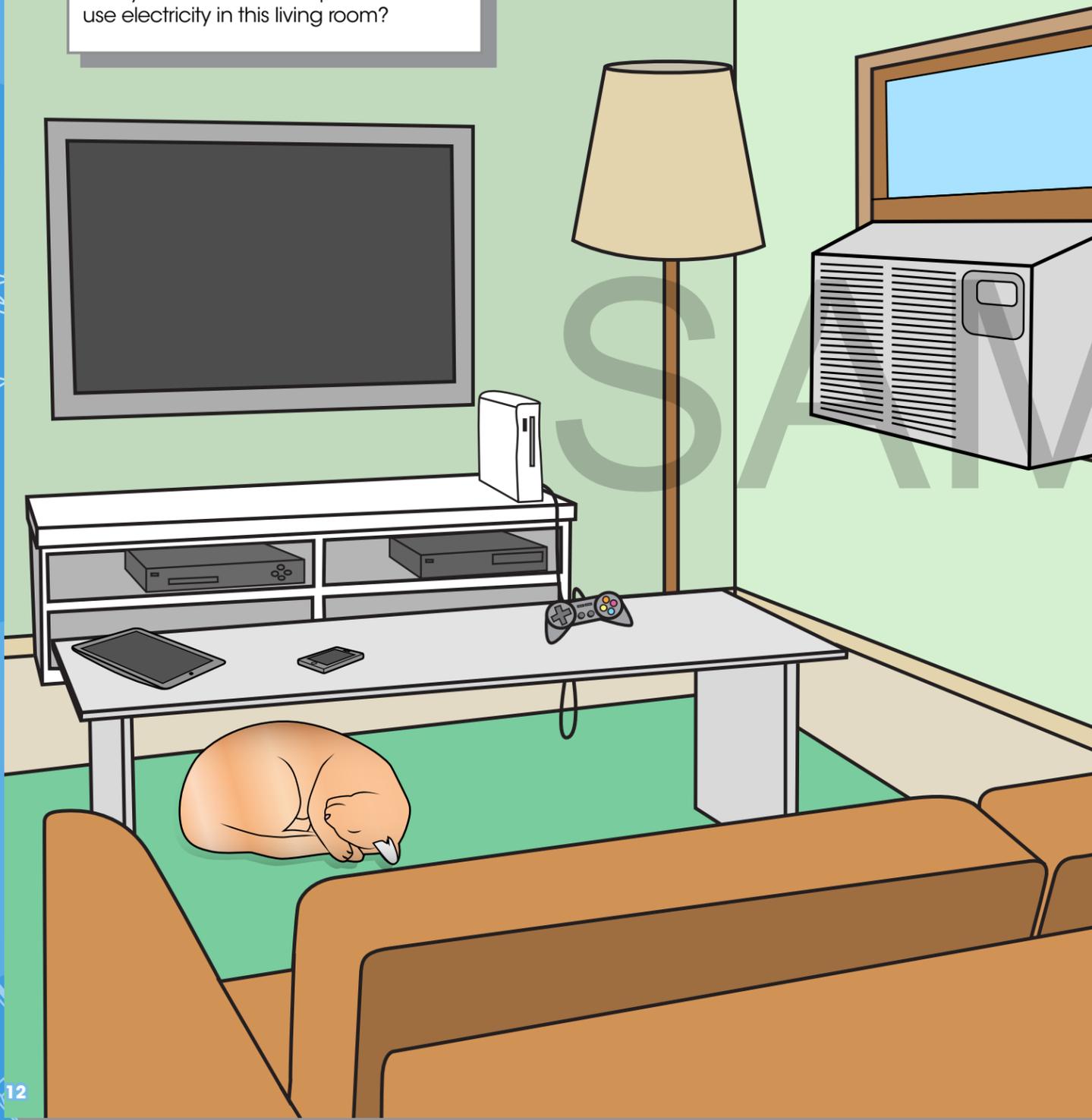
In basic terms, AC current is an electric current in which electron flow can reverse direction. In DC current, electrons flow in only one direction.

# It's Electric!

Without electricity, life at home would be very different! Try this electricity search-and-find game in every room of the house!

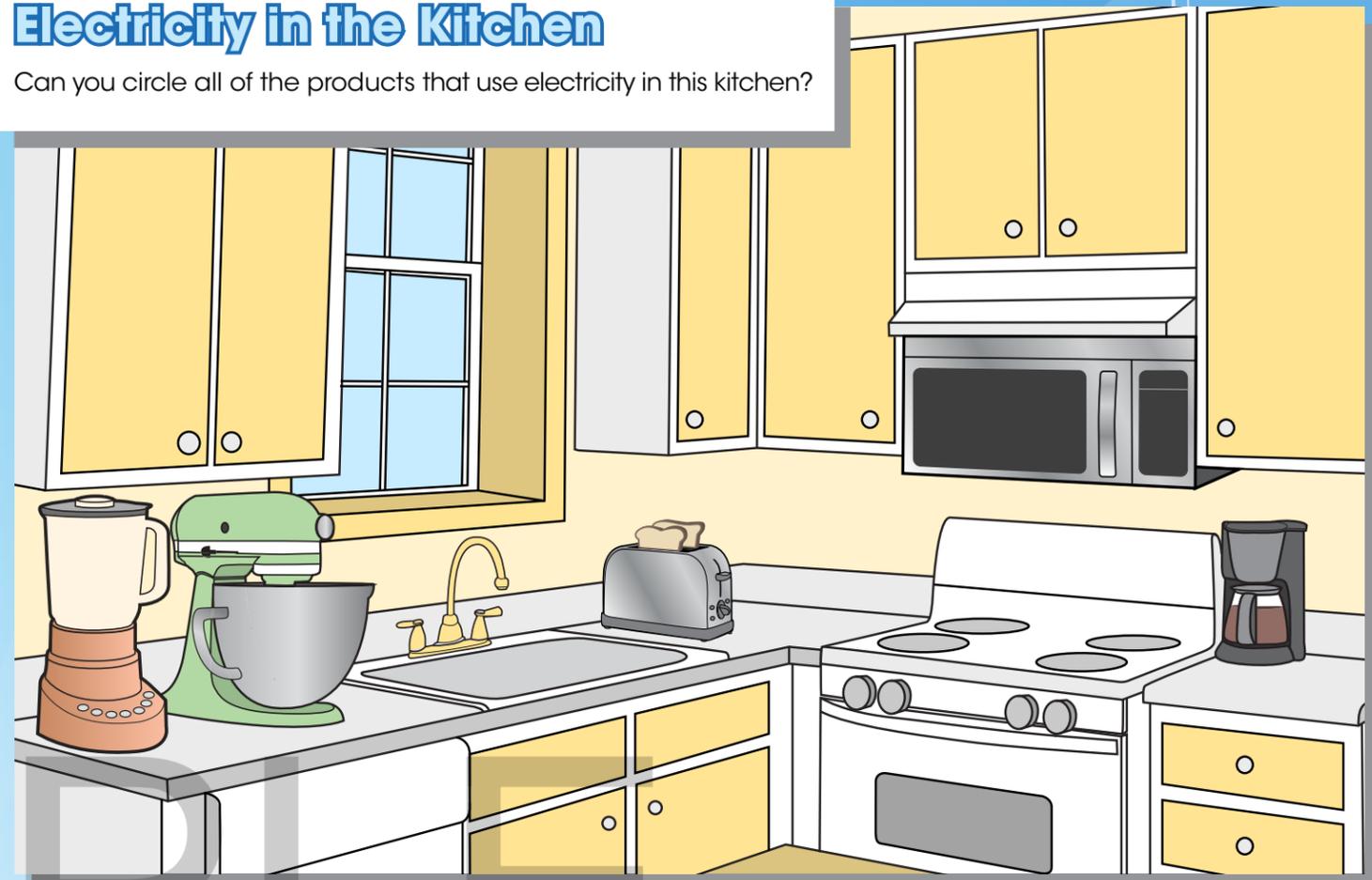
## Electricity in the Living Room

You've learned a lot about electricity. Can you circle all of the products that use electricity in this living room?



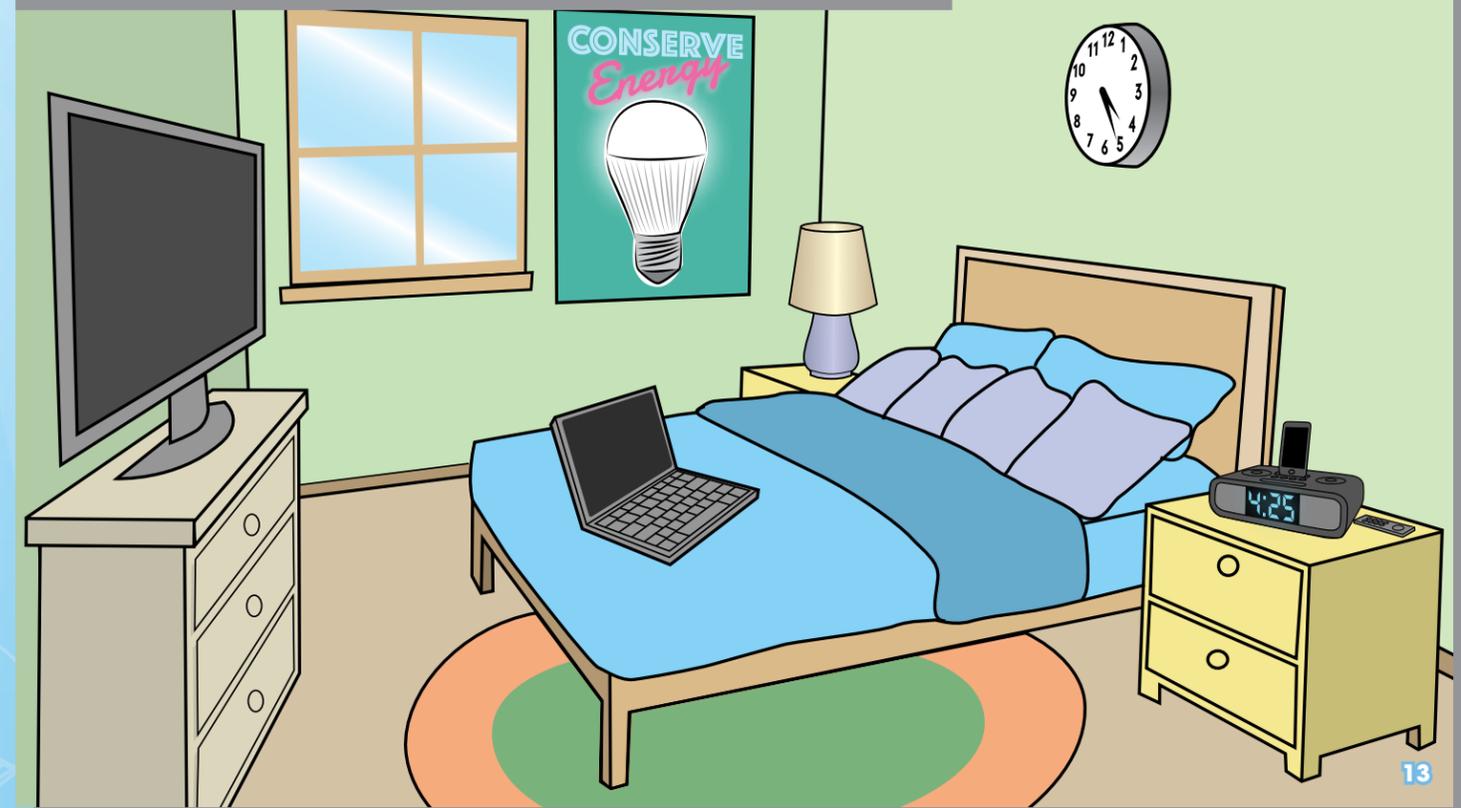
## Electricity in the Kitchen

Can you circle all of the products that use electricity in this kitchen?



## Electricity in the Bedroom

Can you circle all of the products that use electricity in this bedroom?



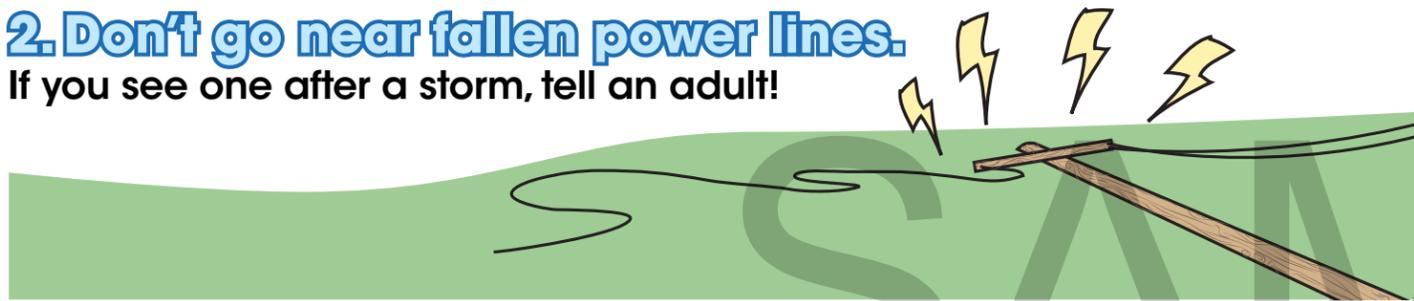
# Electricity Safety

It's very important to be careful around electricity. Electricity is very safe when used correctly. If you keep these electricity safety tips in mind, you can enjoy and use electricity in your home without worry!

**1. Never stick things into electrical sockets.**



**2. Don't go near fallen power lines.**  
If you see one after a storm, tell an adult!

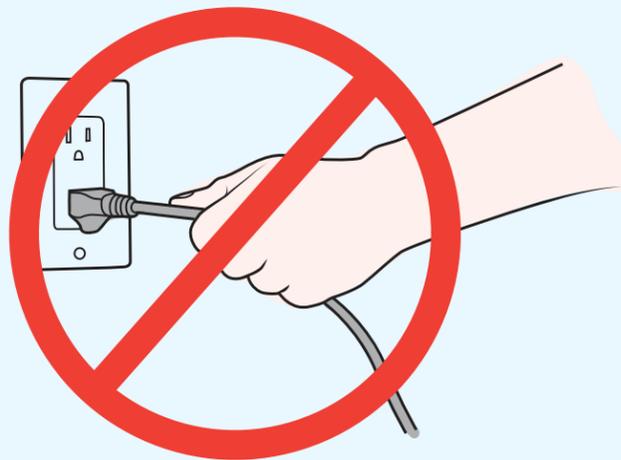


**3. Never use electronics near water.** Electricity can travel through water to your body.

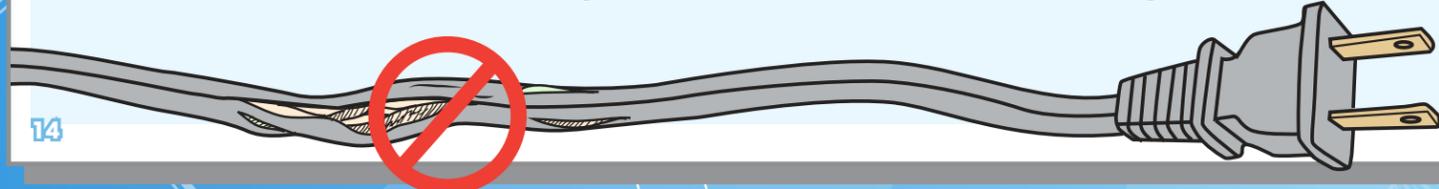


**Danger!**

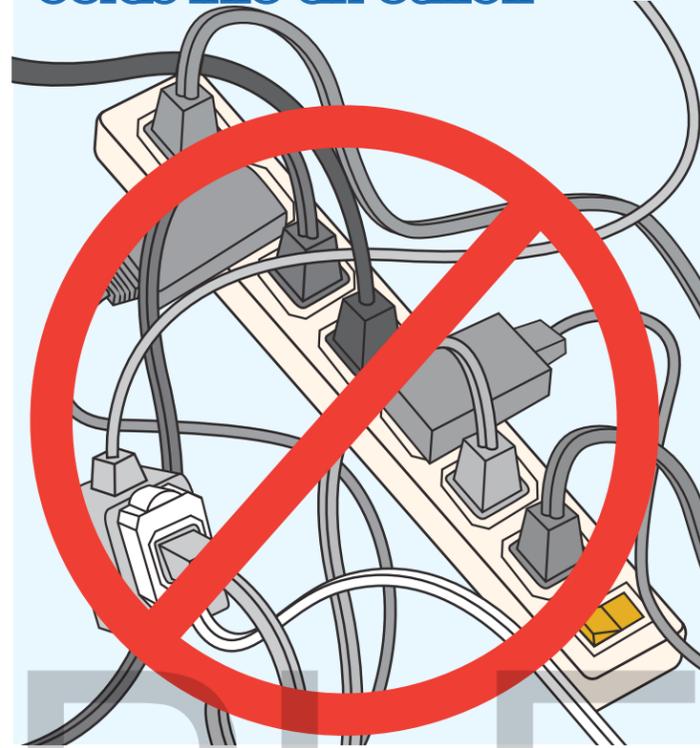
**4. Don't yank the cords of electronics or appliances.**



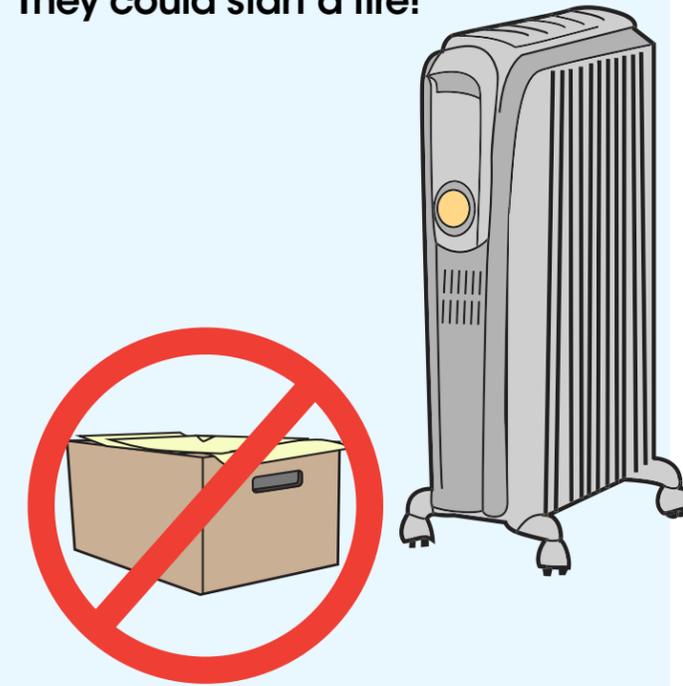
**5. Look out for frayed power cords.** If you see one, tell an adult and don't touch it. Frayed cords can cause a fire in your home.



**6. Don't plug too many cords into an outlet.**

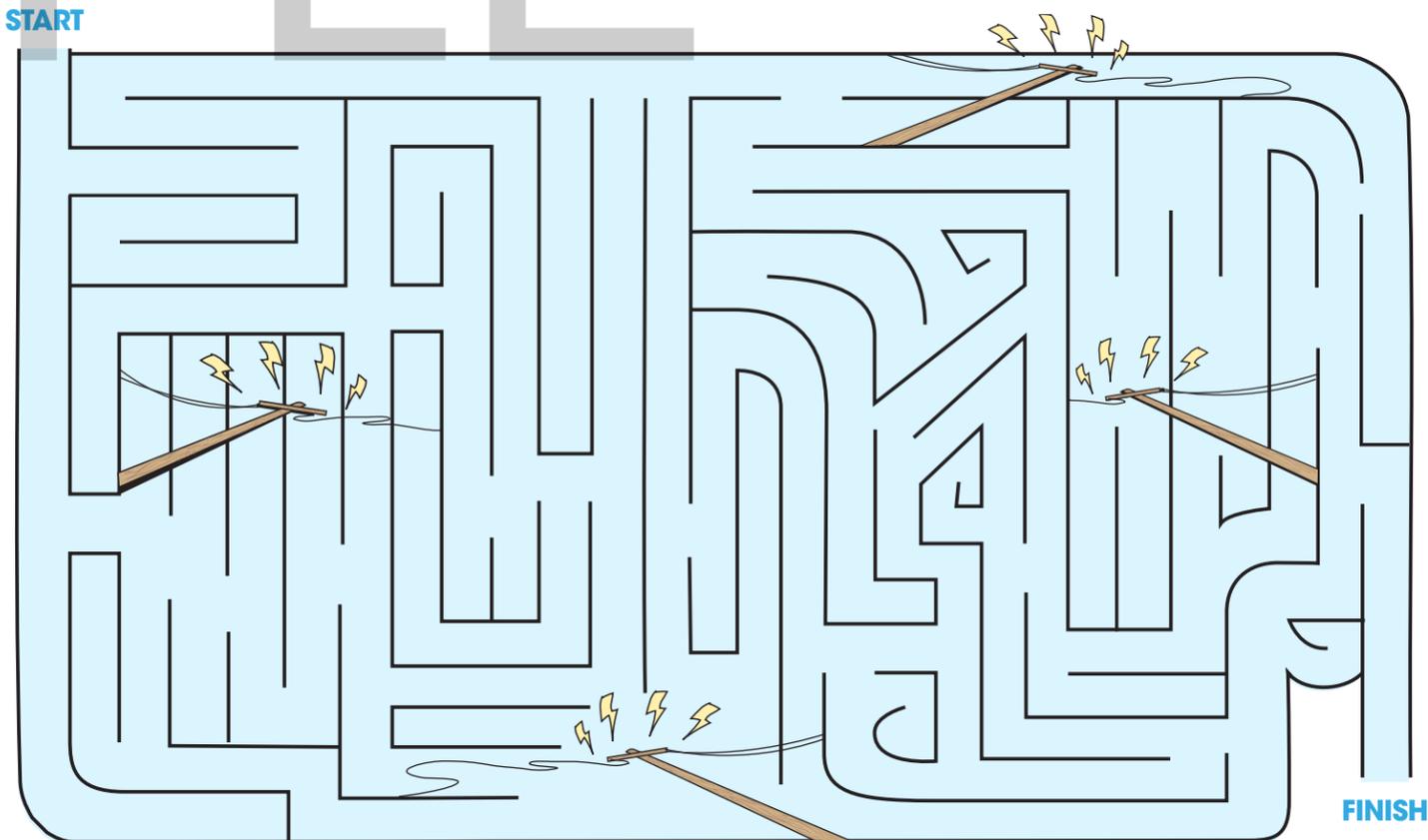


**7. Keep things away from heaters.**  
They could start a fire!



Can you get through this maze without touching any downed power lines?

START



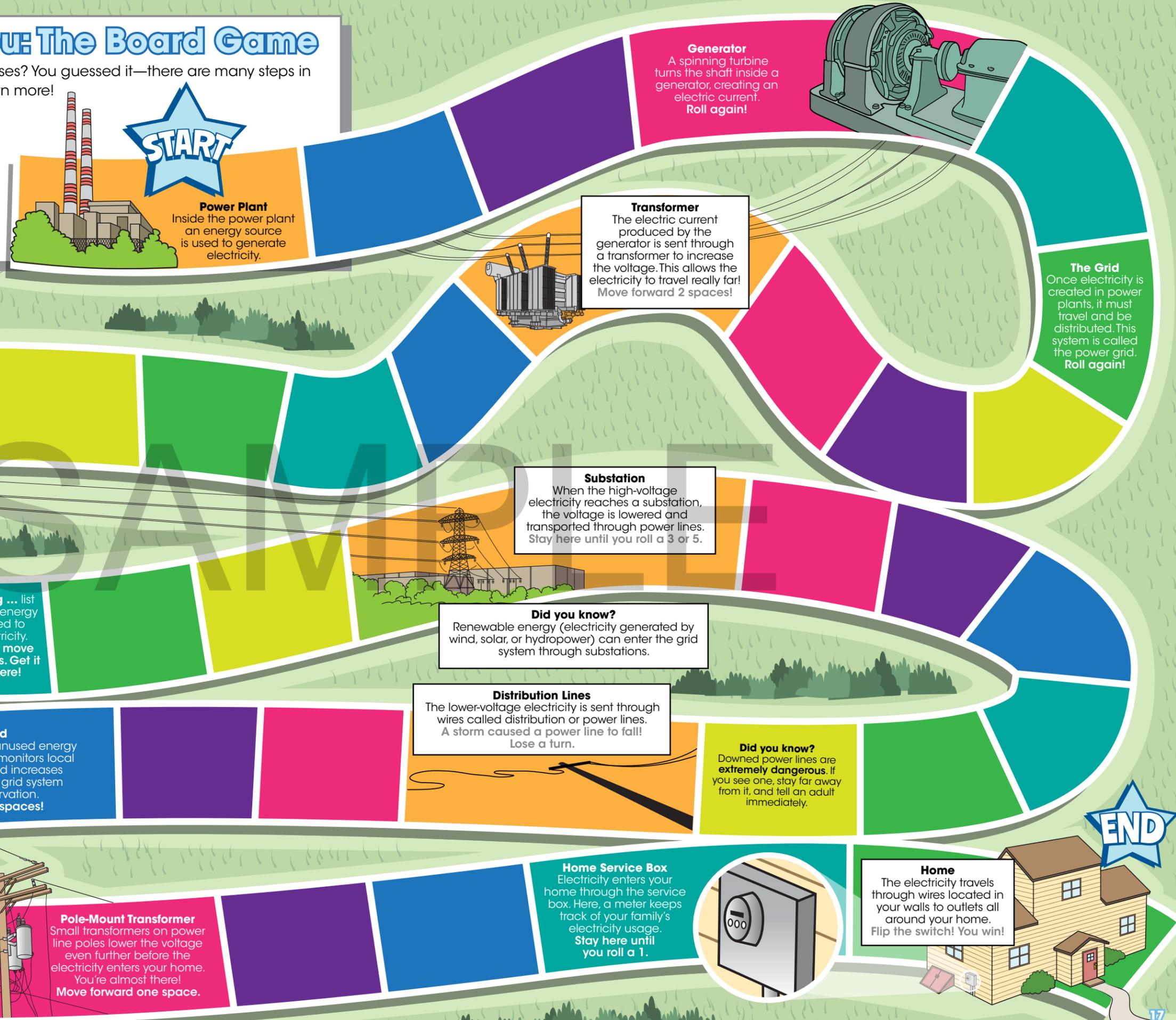
FINISH

# How Electricity Gets to You: The Board Game

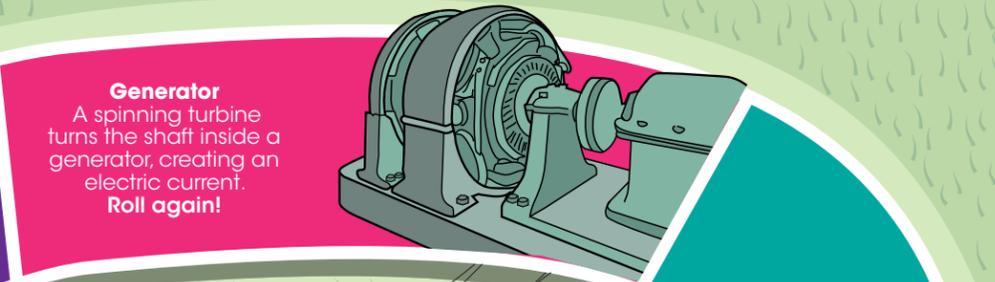
How does electricity get to our homes, schools, and businesses? You guessed it—there are many steps in between! Play the Electricity Distribution board game to learn more!

## How to play:

Each player places a coin, button, or token on the Power Plant and rolls one die. The player who rolls the highest number goes first. Take turns rolling the die to move through the distribution system. If you land on a picture, follow the instructions written next to it. The player who makes it home first is the winner!



**Power Plant**  
Inside the power plant an energy source is used to generate electricity.



**Generator**  
A spinning turbine turns the shaft inside a generator, creating an electric current.  
Roll again!



**Transformer**  
The electric current produced by the generator is sent through a transformer to increase the voltage. This allows the electricity to travel really far!  
Move forward 2 spaces!



**Transmission Lines**  
The high-voltage electricity travels long distances through wires called transmission lines.  
Follow the lines and skip ahead to the substation!



**Substation**  
When the high-voltage electricity reaches a substation, the voltage is lowered and transported through power lines.  
Stay here until you roll a 3 or 5.

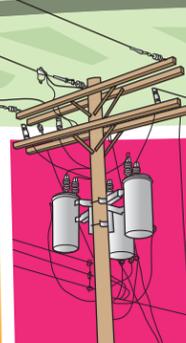
**Without looking ...** list three sources of energy commonly used to generate electricity.  
Get it right and move forward 2 spaces. Get it wrong, stay here!

**Did you know?**  
Renewable energy (electricity generated by wind, solar, or hydropower) can enter the grid system through substations.

**Distribution Lines**  
The lower-voltage electricity is sent through wires called distribution or power lines.  
A storm caused a power line to fall!  
Lose a turn.

**Smart Grid**  
The smart grid allows unused energy to reenter the system, monitors local electricity usage, and increases efficiency. The smart grid system supports conservation.  
Move forward 3 spaces!

**Did you know?**  
Downed power lines are extremely dangerous. If you see one, stay far away from it, and tell an adult immediately.



**Pole-Mount Transformer**  
Small transformers on power line poles lower the voltage even further before the electricity enters your home.  
You're almost there!  
Move forward one space.

**Home Service Box**  
Electricity enters your home through the service box. Here, a meter keeps track of your family's electricity usage.  
Stay here until you roll a 1.



**Home**  
The electricity travels through wires located in your walls to outlets all around your home.  
Flip the switch! You win!



# Saving Electricity in the Home

You use electricity every day, and you can help save it too! Saving electricity can help your family save money on their monthly energy bill. Here you can explore the many ways to become an energy saver at home!

## Laundry Room

Washing machines use both electricity and water, and therefore a lot of energy too. Washing machines can use up to 40 gallons of water per load—that's a whole bathtub full! Energy-efficient washers can use fewer than 10 gallons of water.

To save energy, wash with cold water instead of hot, and only wash and dry full loads. And don't forget to clean out the lint filter! But if you can, hang your clothes outside to dry instead of using the dryer.

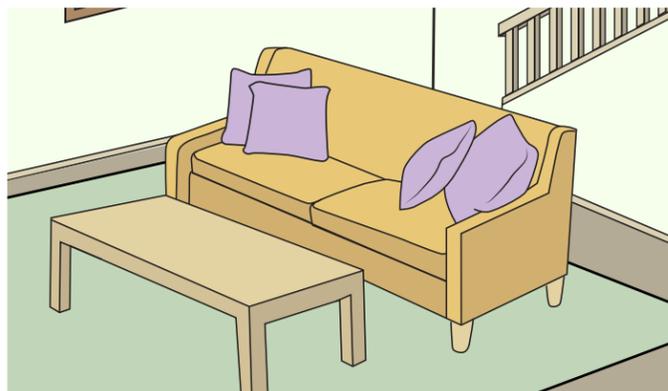


## Living Room

Remind your family to turn off the lights and other electronics, such as computers and televisions, when not in use.

In the summer, use a fan instead of turning on the air conditioner. Cooling your house with an air conditioner uses a lot of energy!

Ask an adult to replace your home's lightbulbs with CFL or LED bulbs. CFL and LED bulbs make more light with less electricity, and they last longer, so they save money too!



## Kitchen

You can save energy by keeping your refrigerator door closed tight. Decide what you want to eat before you open the fridge. Does your family use energy-efficient appliances? These appliances use less energy to work, which can save your family money on their monthly energy bills.



## Brain Teasers

A computer uses 100 watts of electricity per hour. How many watts will your computer need if you use it for two hours per day for one week?

$$\frac{\text{Watts per hour}}{\text{Watts per hour}} \times \frac{\text{hours used (2 hrs} \times \text{7 days)}}{\text{hours used (2 hrs} \times \text{7 days)}} = \frac{\text{total watts needed}}{\text{total watts needed}}$$

On average, an air conditioner uses 4,500 watts of electricity per hour. An electric fan uses about 50 watts per hour. Family A uses an air conditioner for six hours. Family B uses a fan for six hours. How many watts did Family A use? Family B? How many watts of electricity did Family B save by using a fan instead of the air conditioner?

**Family A:**  $\frac{\text{Watts per hour (AC)}}{\text{Watts per hour (AC)}} \times \frac{\text{hours used}}{\text{hours used}} = \frac{\text{total watts used}}{\text{total watts used}}$

**Family B:**  $\frac{\text{Watts per hour (fan)}}{\text{Watts per hour (fan)}} \times \frac{\text{hours used}}{\text{hours used}} = \frac{\text{total watts used}}{\text{total watts used}}$

$$\frac{\text{Total watts Family A}}{\text{Total watts Family A}} - \frac{\text{total watts Family B}}{\text{total watts Family B}} = \frac{\text{watts saved}}{\text{watts saved}}$$

# Word Find

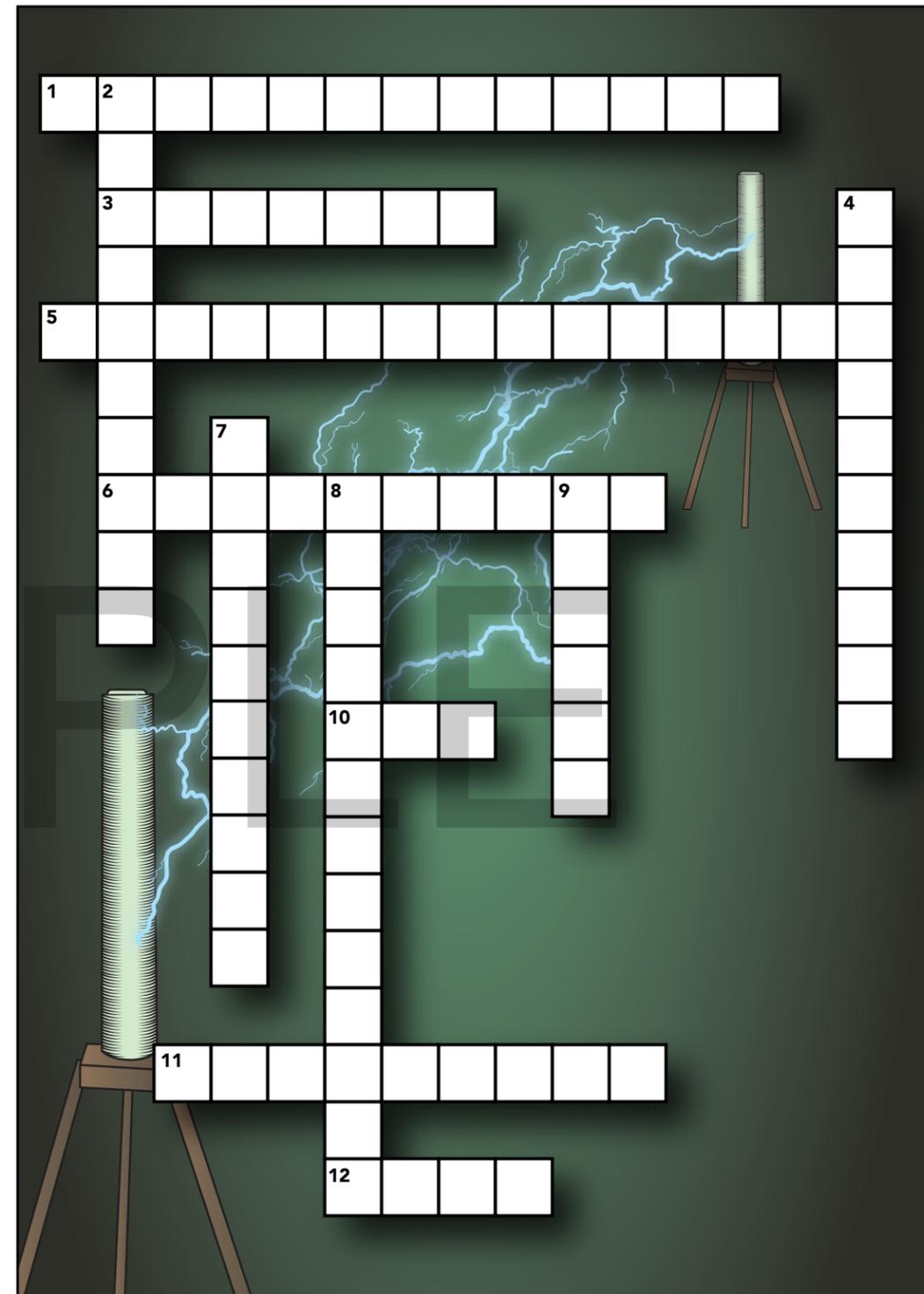
Can you find all the electricity words you've learned in this book? Circle in green the words you know, and circle in red the ones you don't remember!



## Word List

- Atom
- Battery
- Circuit
- Direct current
- Edison
- Electricity
- Electromagnetic
- Electron
- Generator
- Lightbulb
- Lightning rod
- Magnet
- Neutron
- Nucleus
- Proton
- Subatomic particle
- Transformer
- Wire

# Electricity Sources Crossword



## Across

1. Things that are used to generate the electricity we use every day
3. A large machine that captures the energy of the wind to generate electricity
5. Living or dead plant and animal materials
6. Energy created from the heat of the Earth
10. A dark-colored liquid found in reservoirs deep underground
11. Oil can also be called \_\_\_\_\_
12. A blackish rock that is extracted from the Earth and used to make a large portion of the electricity we use every day

## Down

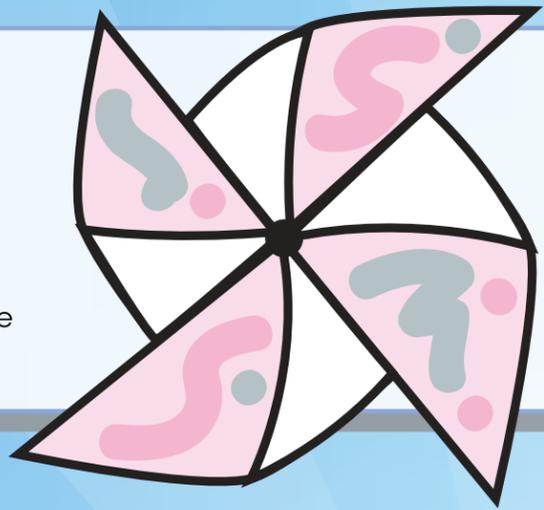
2. Used in many homes for heating and cooking
4. A device that captures the sun's energy to generate electricity
7. The use of the sun's energy to generate electricity
8. Electricity generated from flowing water
9. Nuclear energy is also called \_\_\_\_\_ energy

## World List

- Atomic
- Coal
- Energy sources
- Geothermal
- Hydroelectric
- Natural gas
- Oil
- Organic material
- Petroleum
- Solar panel
- Solar power
- Turbine

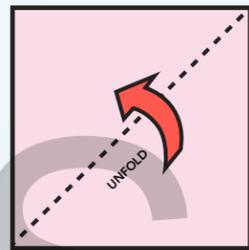
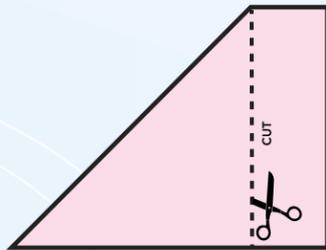
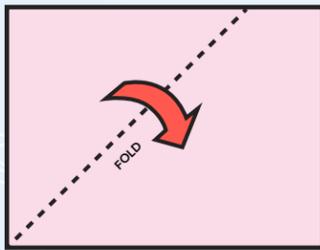
# Energizing Activity!

In this activity you will build a small-scale model of a wind machine inspired by Thomas Edison! Wind machines or turbines capture the energy of the wind to produce electricity. As the wind turns the blades of a turbine, a shaft is rotated. The shaft is connected to a generator to produce electricity. See how the energy of your breath can be used to lift a paperclip—just like the energy of the wind can be used to generate electricity!

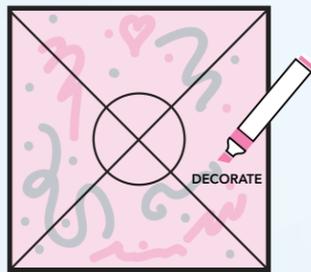
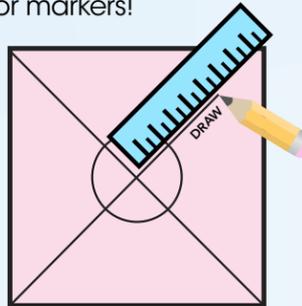


## Instructions:

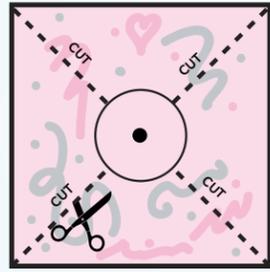
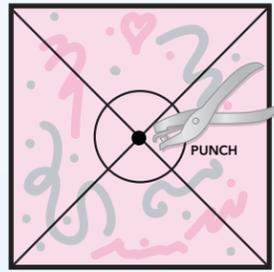
1. Hold a piece of construction paper horizontally, then fold the upper lefthand corner down until it reaches the bottom of the page. Cut off the extra flap of paper and you'll have a perfect square!



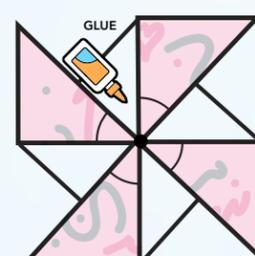
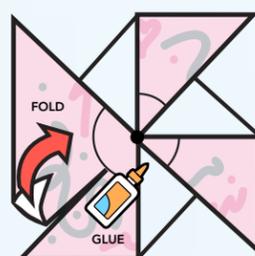
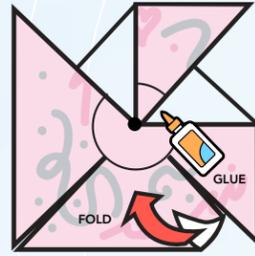
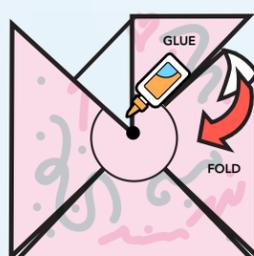
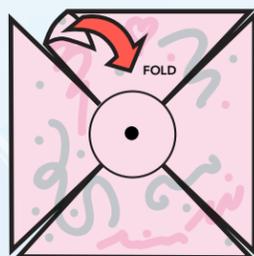
2. With a pencil and ruler, draw an X diagonally on your construction paper square, from corner to corner, and a circle in the center where the lines meet. Now decorate both sides with colored pencils or markers!



3. Punch a hole in the center of the square and then cut along each line. (Don't cut all the way to the center! Stop half an inch from the center where you drew your circle.)



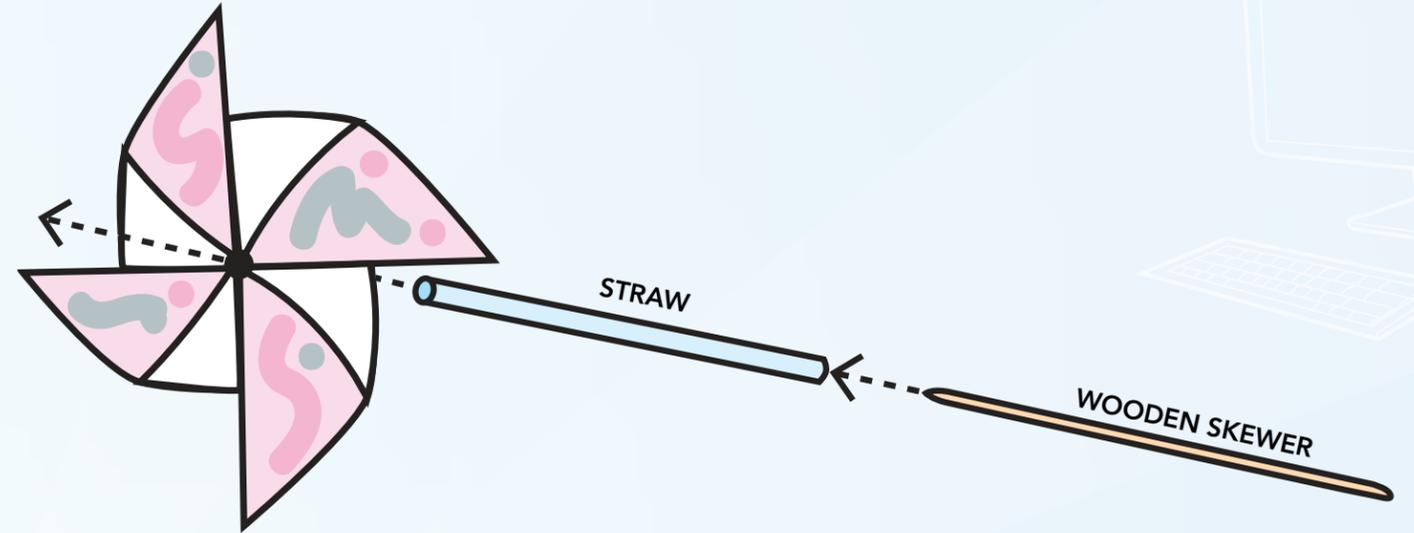
4. Bend the left corner of each section down to the center and glue as shown. These are the "blades" of your wind turbine!



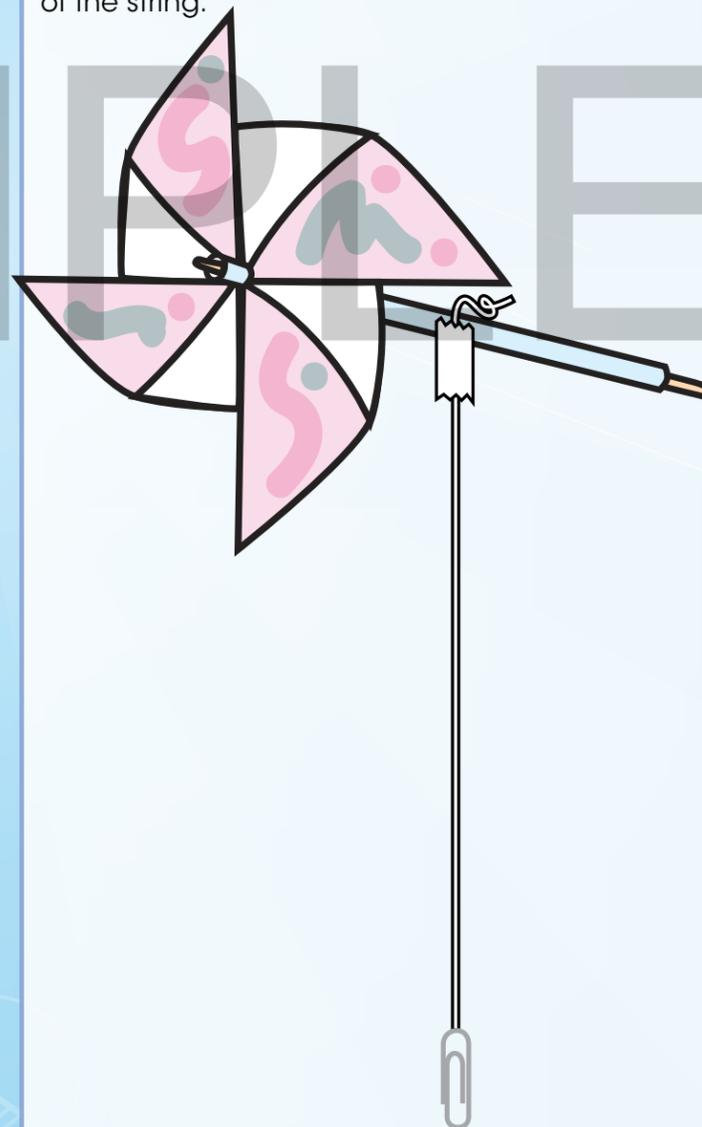
## Materials

- Construction paper
- Plastic straw
- Hole punch
- Wooden skewer
- Glue
- Pencil
- Ruler
- Markers
- Tape
- String
- Paperclip

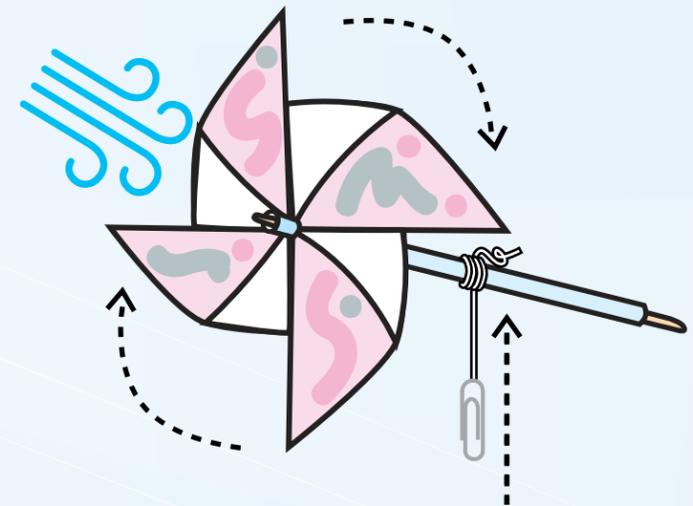
5. Slide the straw through the hole in the center, and then the wooden skewer through the straw.



6. Tape one end of the string to the middle of the straw. Attach a paperclip to the other end of the string.



7. To test your wind turbine, hold the ends of the wooden skewer and blow on the blades. As you blow, the blades will rotate and the straw will turn and lift up the paperclip!



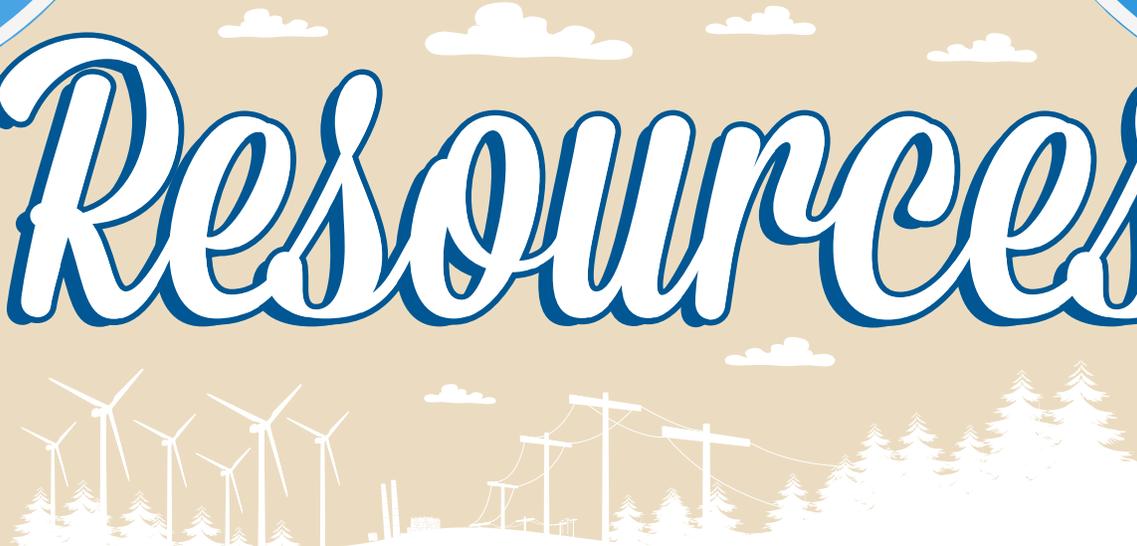
## Did You Know?

Human civilizations have harnessed wind power for thousands of years. Early forms of windmills used wind to grind grain into flour or pump water.

The United States generates more wind energy than any other country except China.

Wind turbines are big. A wind turbine blade can be up to 260 feet long, and a turbine tower can be over 328 feet tall—that's taller than the Statue of Liberty.

# Resources



For more information, check out these great sites!

**U.S. Department of Energy**

[www.energy.gov](http://www.energy.gov)

**U.S. Energy Information Administration**

[www.eia.gov](http://www.eia.gov)

**Energy Star for Kids**

[www.energystar.gov/kids](http://www.energystar.gov/kids)

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