

Electricity



Sangari Active Science, 2nd Edition



sangari **active science**



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Electricity

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Development Center

Electricity



Dear Student,

What happens when you flip a switch on the wall, or push the on/off button on something? What happens when you plug a lamp into the wall? The switch, button, and plug help to get electricity where you need it. You may not think about how electricity is produced, but you probably do know that it's important. Have you ever wondered how electricity can shock a person? Have you wondered what is inside a battery or how it works? How does electricity get to where you live? Is it good or bad for the environment?

You are about to study electricity. You will ask questions, then read and investigate to figure out the answers. Once you ask good questions, and learn how science helps you answer them, you'll keep thinking of new questions to explore!

Sangari Active Science



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Safety

Sangari Active Science

Safety is important. During science activities, make sure to pay attention to the following safety symbols in your Student Lab Manual.



SO
sharp
object



WH
wash
hands



PM
poisonous
material



GO
wear
goggles



ES
energy
source



DT
don't
taste



CU
clean up

Follow these safety tips:

1. Follow your teacher's instructions.
2. Do not touch your face, eyes, nose, or mouth during investigations.
3. Do not mix things together to see what will happen.
4. Tie back long hair, and roll up sleeves before doing investigations.
5. Move everything out of the way that you do not need for science.
6. Tell your teacher right away if you have any accidents or spill anything.





What Is Electricity?



How can you get two objects to repel each other?

What happens when you rub your shoes on a rug and then touch a metal doorknob?

Lab Activity

Building and Using an Electroscope



- 1** Read the instructions for assembling the electroscope. Work with your team to build an electroscope.
 - A.** Replace the metal lid of the mason jar by using it to trace a new lid out of the cardboard. Refer to the example in photograph number 1.
 - B.** Cut two aluminum foil pieces into ovals about the size of a stretched quarter. Carefully punch a small hole in each oval near one edge.
 - C.** Bend the wire at the 9-cm mark. Shape the longer section into a spiral that looks like a snail shell (see photograph number 2).
 - D.** Insert the copper wire through the cardboard top as shown in photograph number 2. Look at photograph number 3 and make sure that the spiral on your copper wire is on top, and outside of the jar.
 - E.** Make a hook at the bottom of the straight section of wire and hang the two aluminum-foil ovals on the hook. Look at photograph number 4 and make sure your setup looks the same.
 - F.** Use tape to secure the cardboard with wire assembly to the top of the glass jar so the wire and foil ovals are inside the jar, but not touching the bottom. Look at photographs numbers 5 and 6 showing the assembled electroscope, and make sure your setup looks the same as the examples. The foils hanging straight down indicate the electroscope is in a neutral, or uncharged state.

- 2** Check to see if your straw has an electric charge by moving it close to the spiral wire part of the electroscope. Record your observations in your *Science Notebook*.

Just as magnets have two poles, there are also two types of electric charges called *positive* and *negative*. However, you cannot see the charges.



Lab Activity

Building and Using an Electroscope Continued



- Charge the plastic straw and bring it near the copper wire to redistribute the electric charge. Refer to photograph number 7 below. Record your observations in your *Science Notebook*.



- 4 Look at the position of the foils in photograph number 8. What does their position mean? Experiment with other materials to see how they react with the electroscope. Record your observations in your *Science Notebook*.



Learn More

Electricity in Nature

Since ancient times, humans have been afraid of thunder and lightning. Zeus, the King of the Gods of Greek mythology, used a lightning bolt as a weapon. Those bolts in stories are similar to the electric currents that make things in your home work.

Lightning is much stronger. When it strikes, it can cause a lot of damage.



The red spot is called a "red sprite." It is an electrical discharge that occurs above the clouds.



Unlike regular lightning bolts, ball lightning remains in the air for several seconds and moves in different directions.

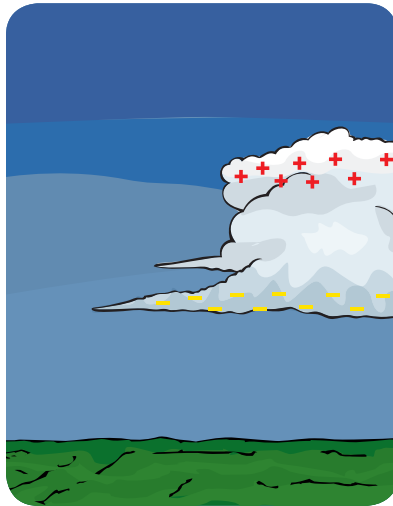
Lightning Bolts

Lightning bolts can happen in a few ways. They can occur between clouds, between clouds and the ground, between a cloud and the atmosphere above it, or inside of just one cloud. The photos in this lesson show some ways that lightning can occur.

Learn Even More

The Origin of Lightning Bolts

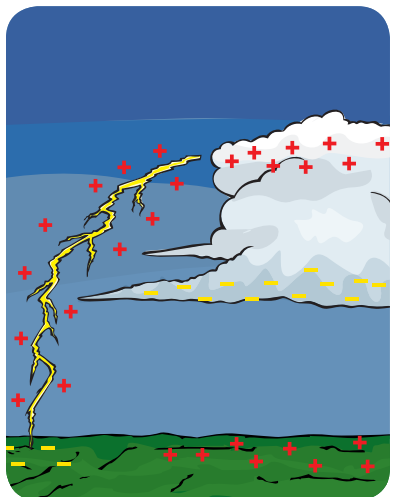
Lightning originates in clouds that are electrically charged. Scientists do not know much about that process. The most accepted theory is that clouds get electrically charged as they collide, or as friction happens between ice particles within a cloud. Lightning can be dangerous, or frightening, but it is important. When lightning occurs, it produces substances (such as nitrogen) important for plants to develop.



Positively charged particles and negatively charged particles separate into different parts of the cloud.



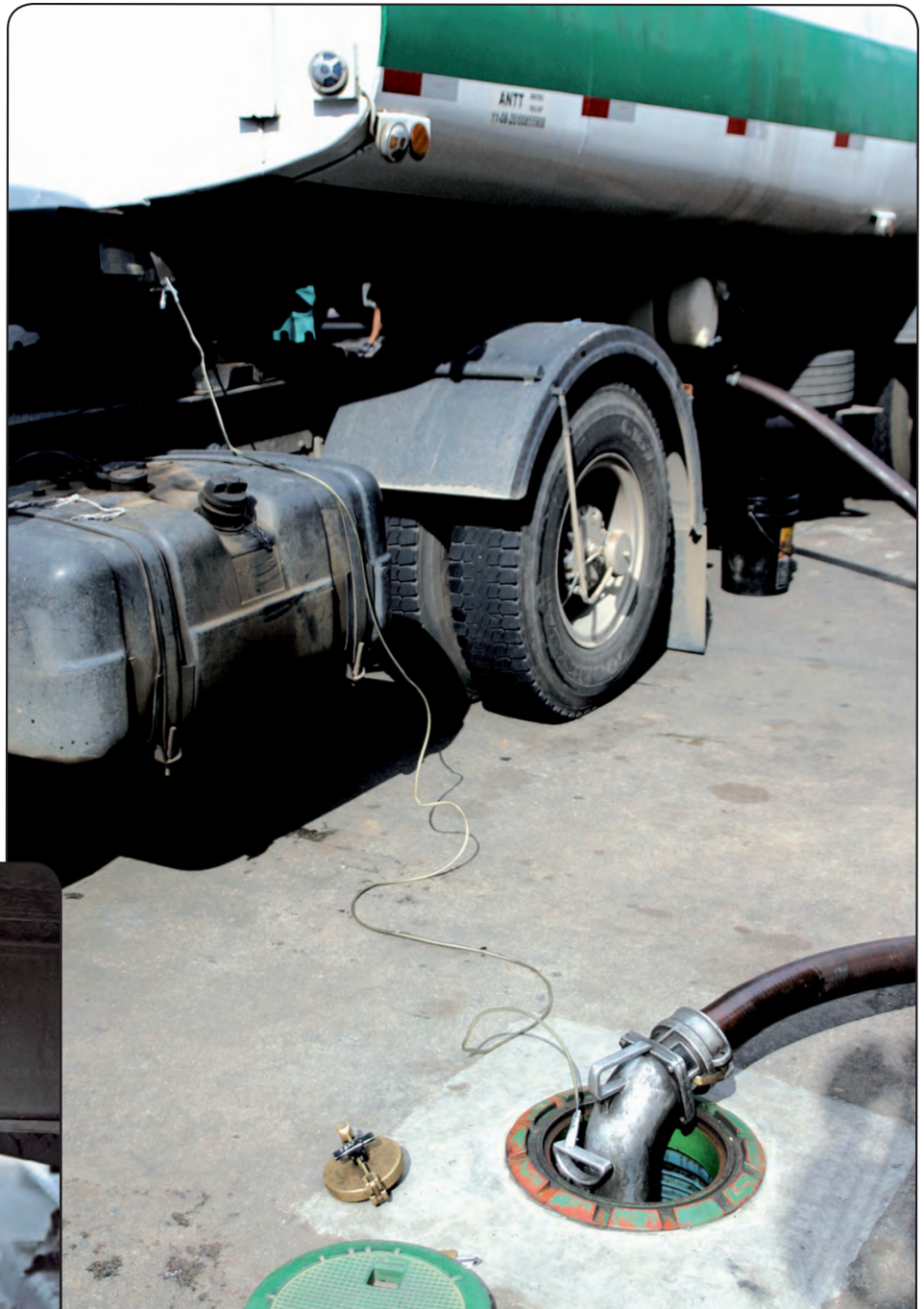
When the electrical charges increase to a certain level, the negative charges descend to the ground or rise toward the positive charges, producing lightning.



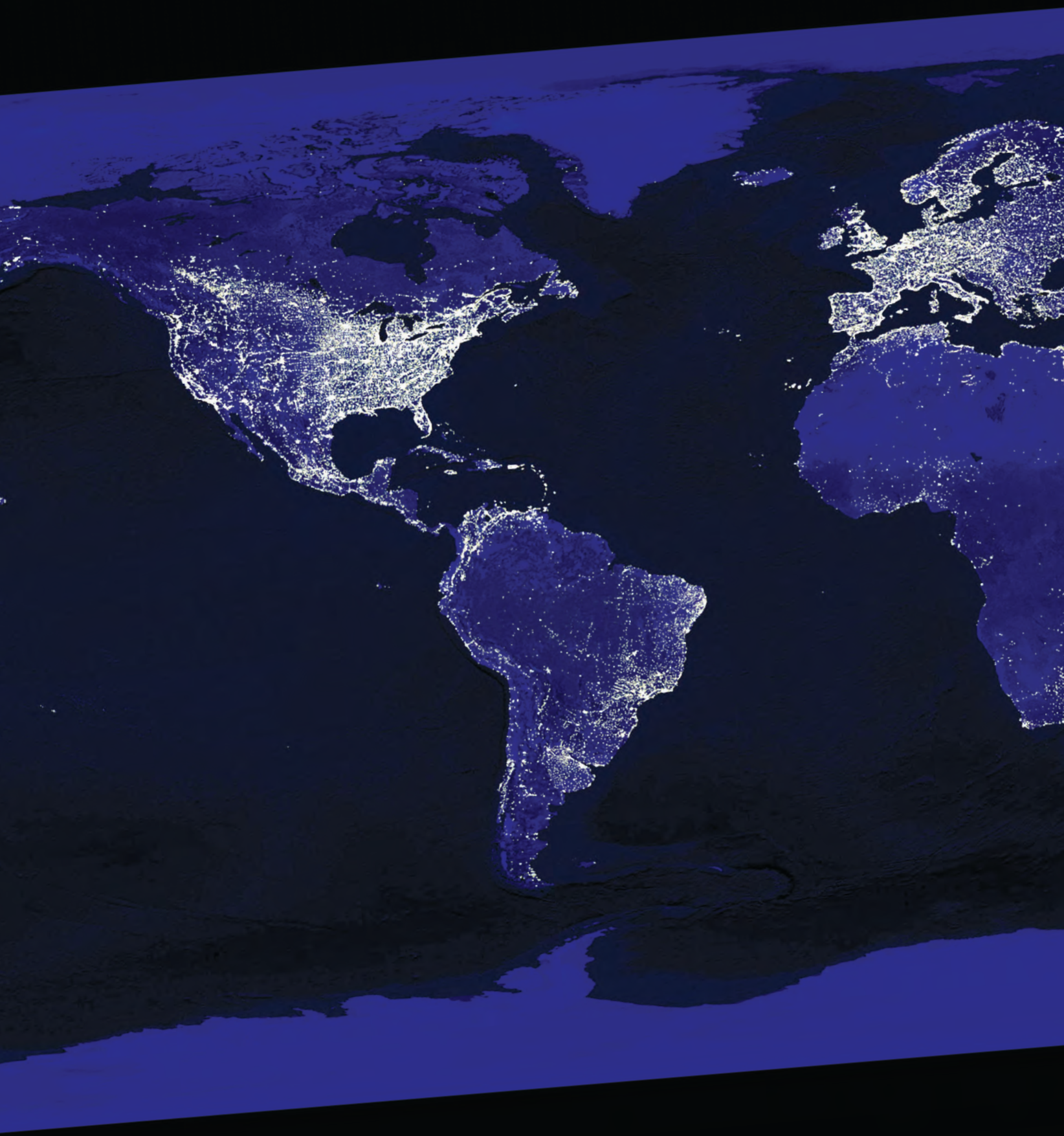
Sometimes an excessive load of positive charges can also produce lightning. These types of discharges are rare and very strong (about 8 times stronger than a negative discharge). They only occur during very intense storms.

Dangerous Sparks

A moving car can develop an electrical charge. This happens because of friction between the road and the air. The electrical charge can produce a spark like a very small lightning bolt. Most of the time, this spark is harmless. But if the spark happens near a flammable liquid, like gasoline, it can start a fire. Tanker trucks that transport fuel have a way to move the charge directly to the ground. A truck driver does this by connecting a wire from the truck to the ground. Then it is safe to unload fuel from the tanker.



The grounding system used in trucks that transport flammable liquids prevents sparks that could cause explosions.



How Can You Light a Lamp?



What items are needed to light a bulb?

How does the arrangement of wires affect the bulb's ability to light up?

Lab Activity

How Can You Light a Bulb?



- 1 Obtain an unfolded box. Assemble your team box along with your teacher.



CAUTION!
Be careful when using these materials. The bulbs will break easily.

- 2 Write your team members' names on the label. Paste the label on the box to identify your materials. You are responsible for keeping your team materials in the box and returning it to the Materials Center at the end of the lesson.



- 3 Obtain a 20-cm piece of wire, a bulb, and a battery.
- 4 Make the bulb light, using just one wire and one battery. Make drawings and write descriptions in your *Science Notebook* to indicate what you have discovered.

Short Circuit

In a house or in a car, short circuits may occur when electricity finds an easier way to make a complete circuit, interrupting the path to a lamp or to an electrical device. In this path, the electric current is so intense that it is capable of melting the wires and creating sparks that can cause a fire.

Short circuits with simple batteries are not dangerous, but they will drain the battery and heat up the wire.

- 5 Look at the drawings of your successful circuit in your *Science Notebook*. Make sure you represent details of the parts of the circuit and the points of contact: the battery to the wire, the wire to the bulb, and the bulb to the battery.
- 6 Define the term *closed circuit* in contrast with an *open circuit*. Draw these terms in your *Science Notebook*. Looking at your successful circuit, how could a short circuit be created? Why is it important to avoid this?
- 7 Explore other ways to light the bulb. Record your investigations in your *Science Notebook*.

Learn More

The Invention of the Light Bulb

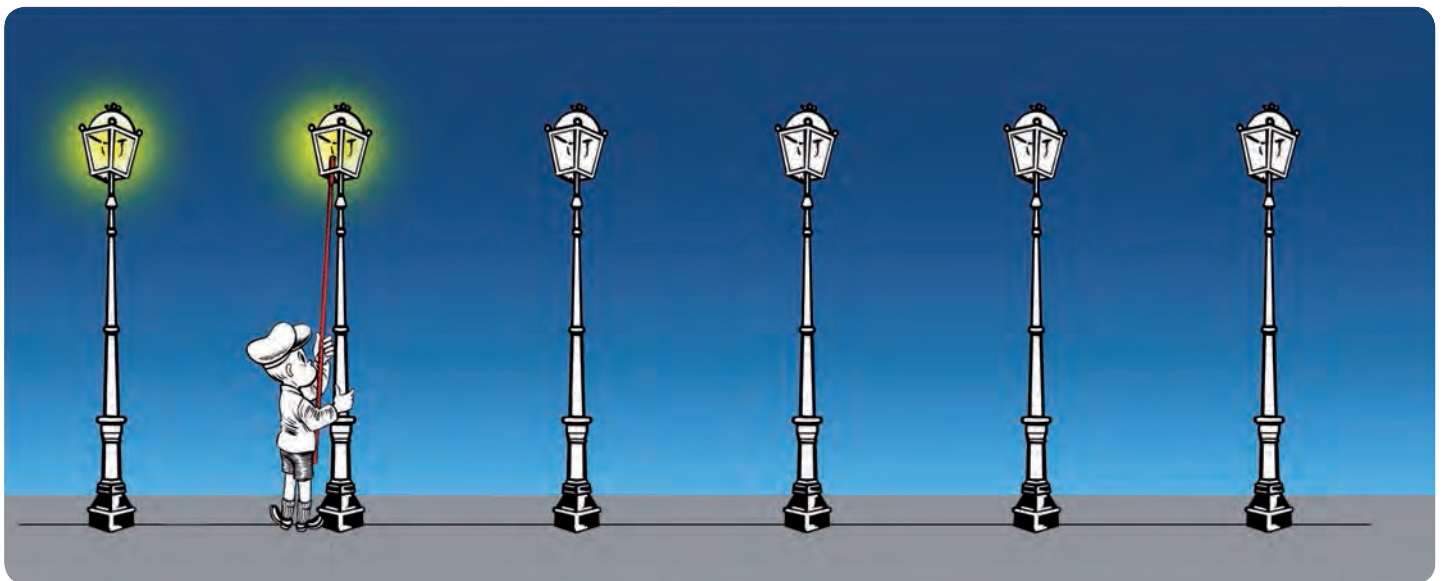
Can you imagine what it would be like to live without electricity? Televisions, showers, elevators, and computers would not work without electricity.

In 1879, Thomas Edison (1847–1931) made the first practical, electric incandescent lamp. Today, this is referred to as a *light*

bulb. Edison's lamp burned for over 40 hours. It began an amazing technological revolution of inventions.

During 1880, Edison continued improving his invention until he produced a bulb that could last 1,500 hours. In Edison's time, few streets were lit at night. Illumination was provided by gas lights that had to be lit one by one every day and then the flame had to be put out the next morning. In 1881, Edison installed 7,200 electric lamps in New

York City. This lit an entire neighborhood! A switch turned them on and off. No one had to light them and then extinguish the flame each day. To many people at the time, it seemed like a miracle or like magic. From then on, everyone who learned about Thomas Edison's invention wanted to light streets and homes with electric lamps. This was when electric wires began to be put across cities. Eventually, electricity could reach people across the country.



The old gas lights were lit individually every evening.

From Ideas to Inventions

Besides the electric incandescent lamp, Thomas Edison invented hundreds of other electrical items. He invented the first film projector, the first voice recorder, and the first electric train. He invented so many

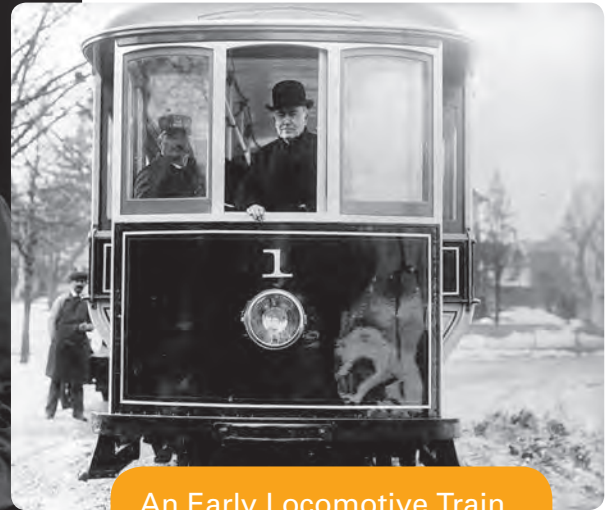
things that he has been called the King of Inventors. He was very curious and very creative. He studied and worked hard to explore and to learn new things.

To develop his inventions, he thought about what would make life easier. He tried many ideas that did not work. The light bulb took many trials before Edison's team

could make it work the way they wanted it to. He tested his ideas many times. He worked to improve the good ones, and threw out the rest. In this unit, you will have many opportunities to carry out experiments and test ideas. As you do this, you'll have a bit of an idea of where ideas come from and of what scientists and inventors do.



Thomas A. Edison holding in his hand a replica of the first incandescent lamp. This lamp produced a light of about 48 watts. Using the same principle, it was possible to build other and more powerful lamps, like the large one at his side.



An Early Locomotive Train



What Is the Path of the Electric Current?



How is the sequence of wire, battery, and bulb important in creating light?

Does electricity travel in only one direction?

Lab Activity



Does It Light?

- 1 Explain the difference between a prediction and a guess.
- 2 Examine the drawing you made in *Lesson 2* when you were challenged to light a bulb.
- 3 Refer to the *Does It Light?* chart in your *Science Notebook*. Record your predictions on it in the appropriate columns.
- 4 Use a battery, a wire, and a bulb to test your predictions.
 - How were the results different from what you expected?
 - How can you explain this?

Does It Light?

Figure	Predictions	Results	
	Will it light? Yes or No	Justification (Reasons for your choice)	Was your prediction supported?
1			
2			
3			
4			
5			
6			
7			
8			
9			

Learn More

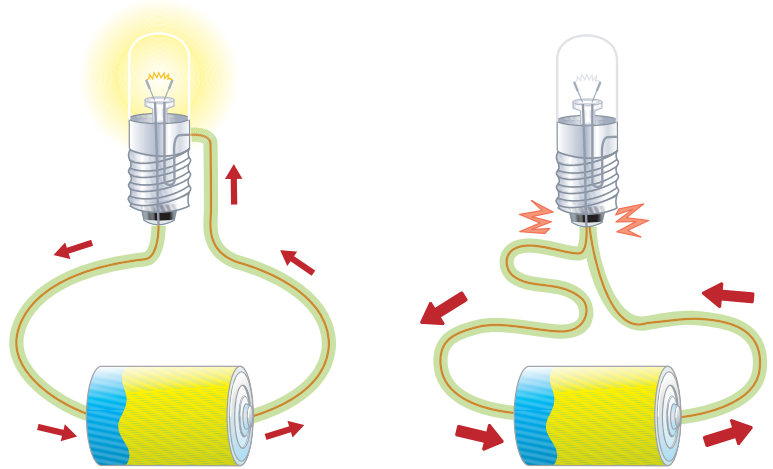
Electric Circuit and Short Circuit

Have you ever heard the term *short circuit*? An electrical circuit is made up of a battery, a wire, and a light bulb. Electrical charges leave the positive end (pole) of a battery, flow through the wires and the lamp, and enter the negative end (pole). This movement of electrical charges through all the parts is called an *electric current*.

Lamps, motors, and other electronic equipment have resistors, such as a bulb, that limit how much charge flows through the wires. If the battery's poles are connected by a wire without going through a bulb or some other resistant elements, the amount of charges flowing through the wire would be

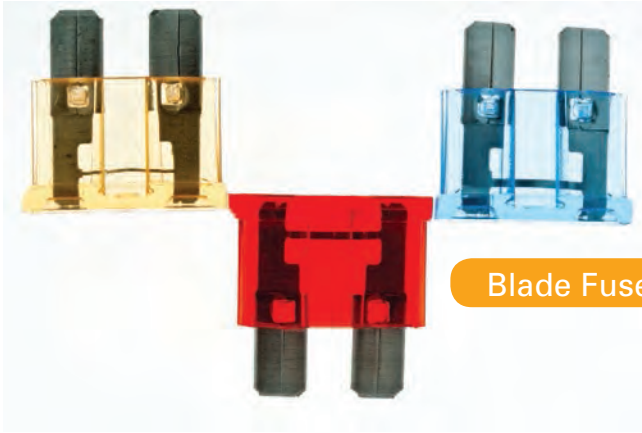
much greater. This direct connection is what is called a *short circuit*.

One major consequence of a short circuit is a sudden and intense increase of electric current. This can cause overheating and damage to electrical objects. A short circuit may cause a fire. It may drain the power from a battery. If two wires inside a house have their plastic coating removed, they can touch each other and create a short circuit. Not all short circuits are dangerous, but to prevent fires, all houses have fuses or circuit breakers that stop the flow of electricity when there is danger of overheating.

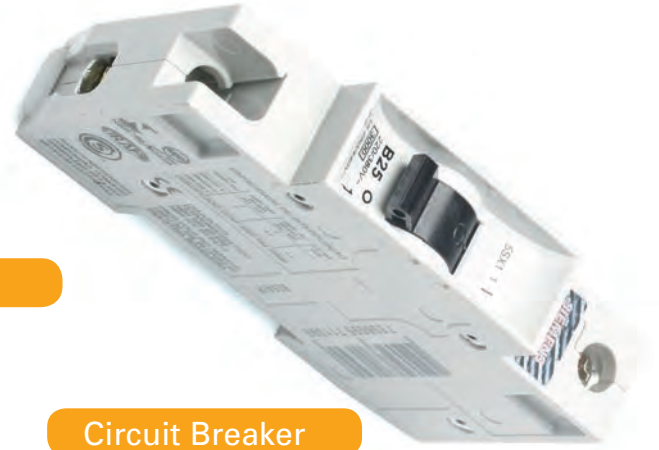


When the electric current circulates without flowing through the lamp or other device, a short circuit occurs.





Blade Fuse



Circuit Breaker

Protection Devices

Fuses and circuit breakers offer protection where there is electricity. If a short circuit occurs, the rising temperature breaks or melts the fuse. With no fuse, the electric current cannot circulate. High temperatures disarm circuit breakers. They interrupt the electric current like a switch. Fuses and circuits prevent serious damage to the electrical components of cars, houses, and many devices.



Threaded Fuse

ATTENTION!

In homes and buildings, the electrical energy is much greater than the energy supplied by batteries. This represents real danger. You should never touch the electrical box in a house. And you should never test the wall outlets. The shock could hurt you very seriously, or do something even worse!



How Can We Design a Flashlight?



What are the necessary parts of a flashlight?

What type of circuit is found in a flashlight?

Lab Activity

Designing a Flashlight



1 You will design a flashlight. These are the three requirements of the project:

- It must have a switch so it can be turned on and off.
- It must produce the best possible brightness with only two batteries.
- It must be portable and easy to use and handle.





2 Discuss the flashlight's assembly with your partner. Focus on the following questions:

- What materials will you use?
- How will the flashlight be assembled?
- How will the switch work?



3 Draw the flashlight and label all of its components in your *Science Notebook*.

4 Discuss the designs. Make any necessary changes to your design.

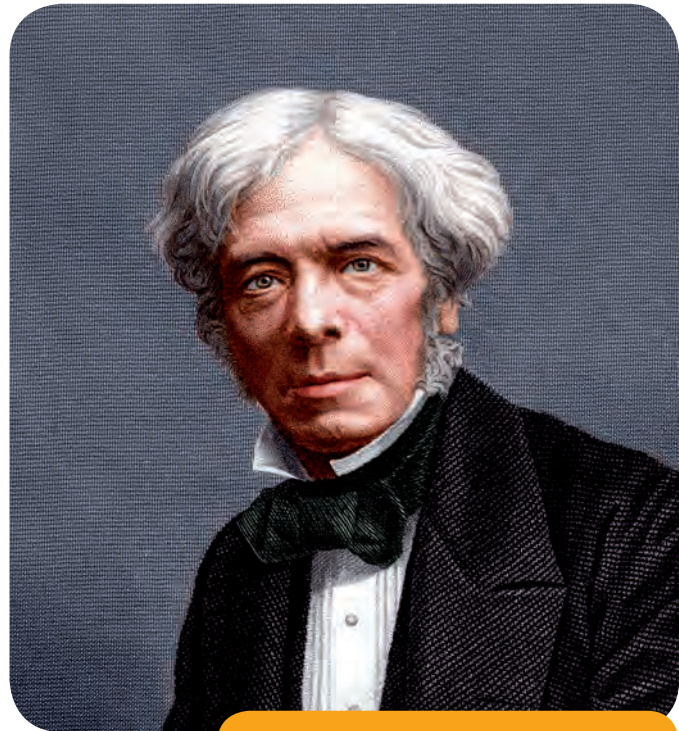
5 Using the materials from the box, test your ideas about the different circuits you will be able to use. During the next lesson you will build the flashlight.



Learn More

Michael Faraday

People today owe a lot to Michael Faraday (1791–1867). His family was poor, so Faraday got a job at age 14. Due to his work schedule, he could not keep up with his studies in school. He once said that besides learning some mathematics, he barely learned how to read and write in school, but that did not stop him from wanting to learn. In his first job as an apprentice to a bookbinder, he learned to read the books he helped to produce. He became more and more interested in science, especially in chemistry. One day, Faraday was invited to attend a lecture by Humphry Davy, a famous chemist of that time. Faraday took notes on Davy's talk, bound the text into a book, and sent it to Davy. With it, Faraday also sent a letter asking if he could meet Davy. Impressed with Faraday's organization, Davy later hired him to work as an assistant in his laboratory.

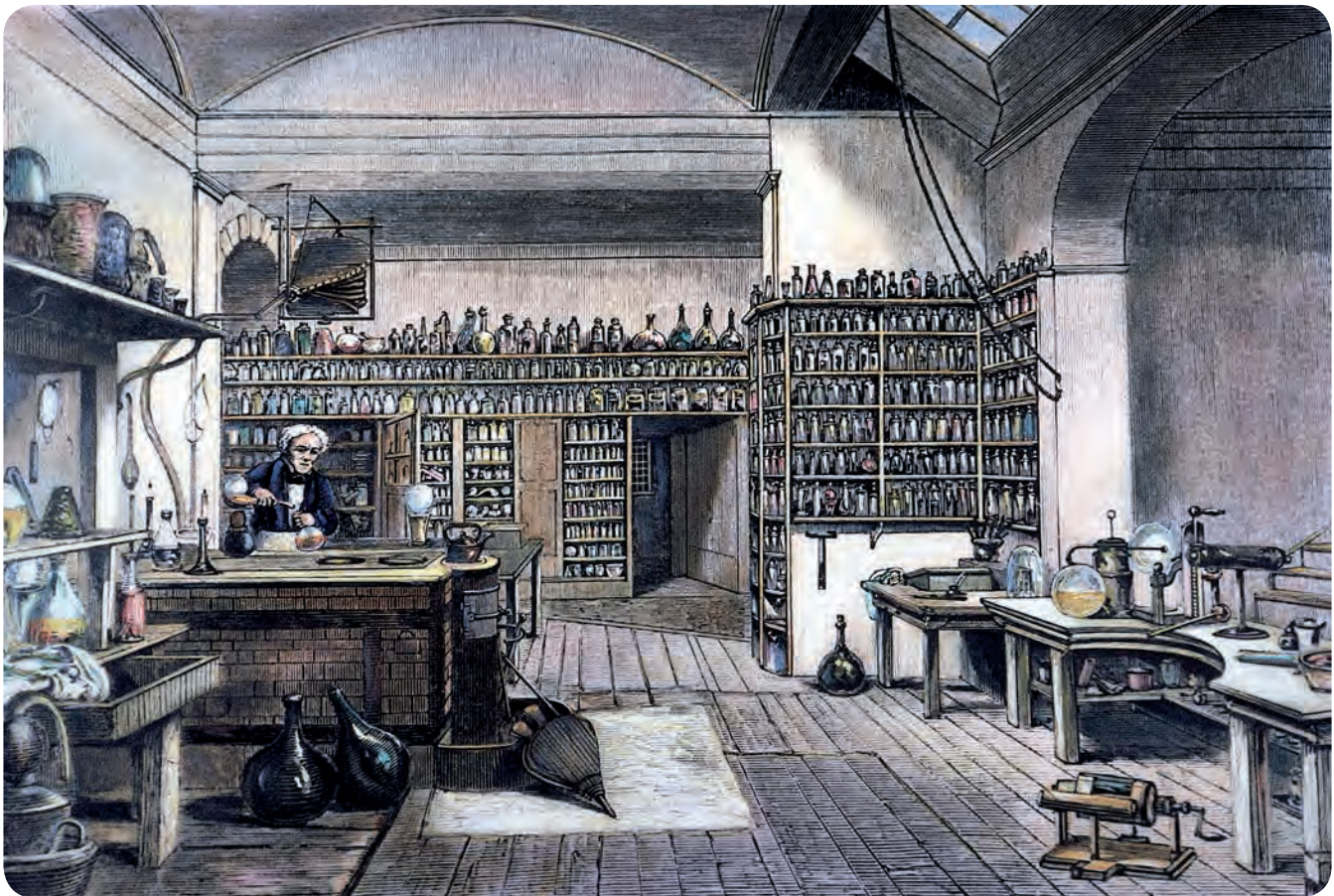


Michael Faraday

Records of Ideas

Faraday always took detailed notes of his activities and experiments in the lab. His laboratory notebooks, known as *journals*, are full of the experiments he did and of the

results—whether they were positive or negative. Faraday's journals have served as inspiration and reference for scientists all over the world. Because of the results he obtained and the records he kept long ago, you can use electrical energy where you live.



Reproduction of Faraday's Laboratory

