California Science

California Science

Genre	Comprehension Skill	Text Features	Science Content
Nonfiction	Cause and Effect	• Labels • Call Outs • Captions • Glossary	Electricity

Scott Foresman Science 4.1

PEARSON
Scott Foresman
scottforesman.com

ISBN 0-328-23542-3
9 780328 235421 90000

Physical Sciences

The Light Bulb

by Lillian Duggan

Vocabulary

electric charge
electric current
parallel circuit
resistance
series circuit
static electricity

Extended Vocabulary

electromagnetic induction
fluorescent lamp
global warming
incandescent lamp
kerosene
lasers
light pollution

Picture Credits
Every effort has been made to secure permission and provide appropriate credit for photographic material.
The publisher deeply regrets any omission and pledges to correct errors called to its attention in subsequent editions.

Photo locators denoted as follows: Top (T), Center (C), Bottom (B), Left (L), Right (R), Background (Bkgd).

5 (CR, BL) Science Museum, London/DK Images; 6 Museum of the City of New York/Corbis; 7 Science Museum, London/DK Images; 8 Clive Streeter/Courtesy of The Science Museum, London/DK Images; 9 (CL) Hulton-Deutsch Collection/Corbis, (TR) Science Museum, London/DK Images; 10 (BL) Schenectady Museum/Hall of Electrical History Foundation/Corbis, (R) The Science Museum/©Dorling Kindersley; 13 (B) Maximillian Stock Ltd/Photo Researchers, Inc.;
14 Planetary Visions Ltd/Photo Researchers, Inc.

Unless otherwise acknowledged, all photographs are the copyright © of Dorling Kindersley, a division of Pearson.

ISBN: 0-328-23542-3

1 2 3 4 5 6 7 8 9 10 V010 13 12 11 10 09 08 07 06

The Light Bulb

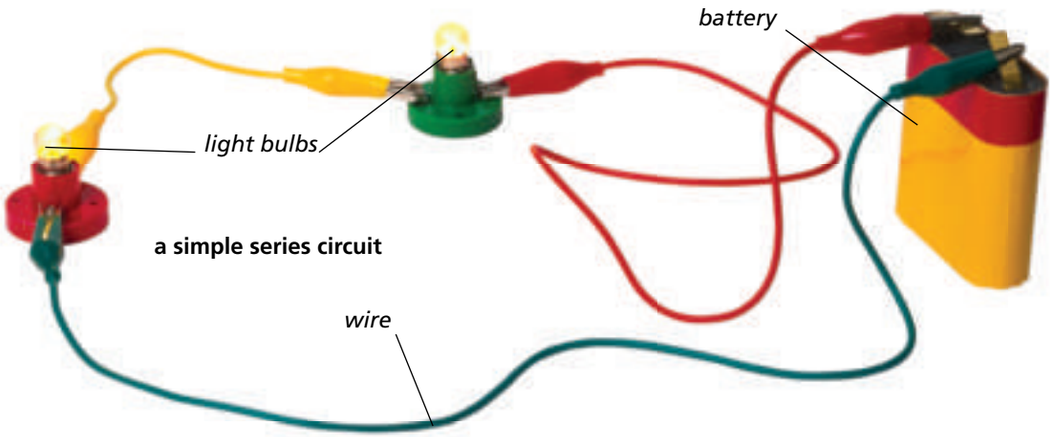
by Lillian Duggan

PEARSON
Scott Foresman

What You Already Know

Matter is made of tiny particles called atoms. Atoms are made of even tinier particles. Some of these particles carry an electric charge. An electric charge is a tiny amount of energy. Electric charges can be positive or negative. Matter can be positively charged, negatively charged, or neutral. Objects with like charges repel each other, and objects with unlike charges attract each other.

Negatively charged particles are called electrons. Electrons can move from one object to another when objects are close together. The built-up charges are static electricity. Static electricity can make your hair stand on end! It also causes lightning. A statically charged object can even pick up neutrally charged objects by attracting the positively charged particles in the object and repelling the negatively charged ones.



a simple series circuit

Electric charges in motion are called electric current. Current flows along a path called an electrical circuit. Most circuits have resistors, or materials that resist the flow of electric current. Resistance means a material does not allow electric current to flow through it easily. Resistors turn electrical energy into other types of energy, often heat or light.


This television must be on a circuit to work.

There are different kinds of circuits. In a series circuit, electric charge can flow only in one circular path. If there is a break in the path, the current stops flowing. Current is shared equally among all resistors on a series circuit.

Parallel circuits are more practical for wiring buildings. A parallel circuit has two or more paths through which current can flow. This means that if there is a break in one path, the other paths still have current. These circuits also allow resistors to get different amounts of current.

The light bulb is probably the most familiar electrical device in the world. Let's look at how the light bulb was developed, and how it has changed our lives.

Making Light

Electric lighting was invented less than 150 years ago. Before that, people used fire to make light. Over the centuries, fire was used in several different forms. About 40,000 B.C., people started using fire in lamps to make light. The first lamps were made of hollowed-out rocks, shells, or pottery. They were filled with a material soaked in animal fat. The burning fat gave off light. The ancient Egyptians used a saucer lamp with a notch that held the wick. The wick controlled how fast the fat burned.

Burning wood creates warmth and light.

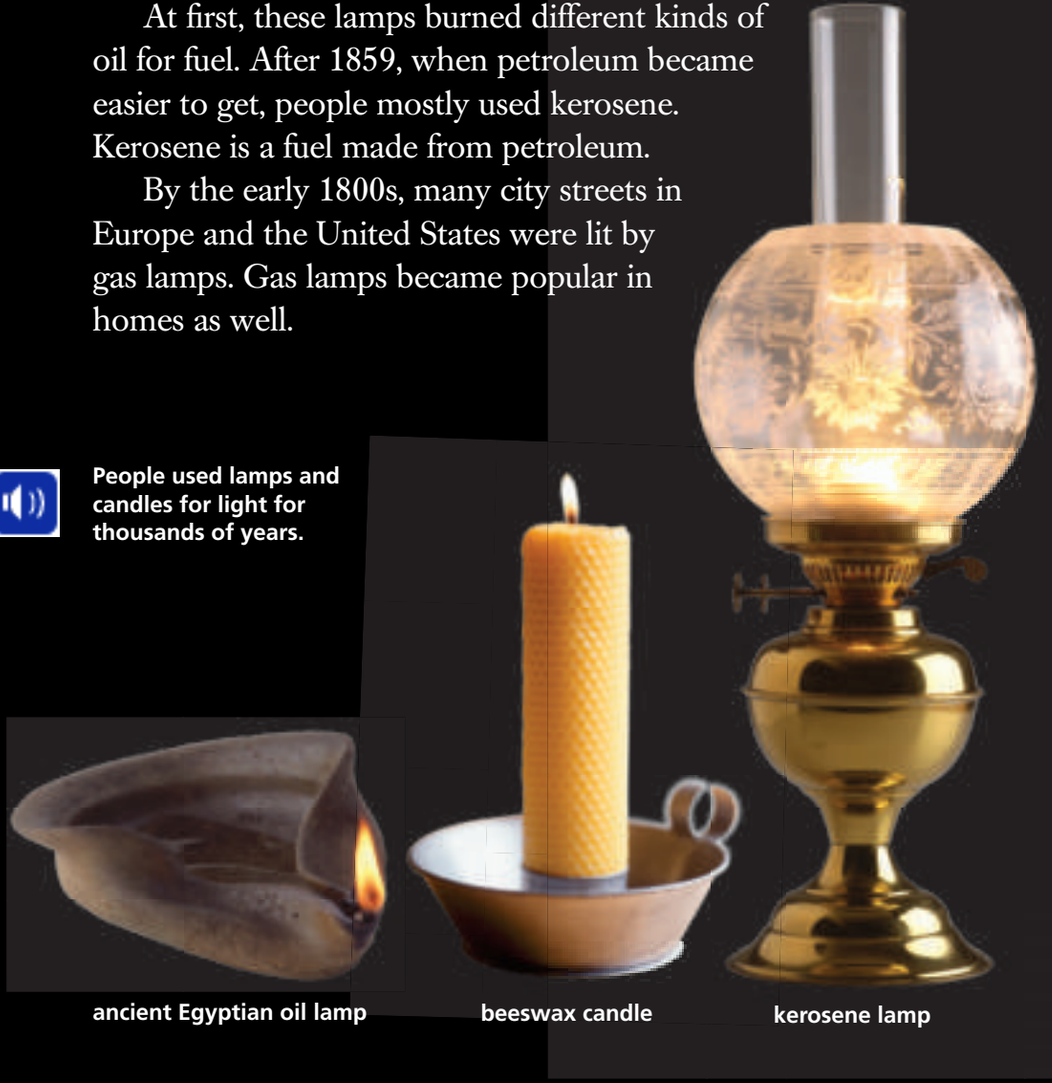
Later, candles were used to make light. These were made of a wick surrounded by solid beeswax or animal fat.

In the 1700s, lamps like the kerosene lamp shown below were made. These lamps have a burner that creates a flame. The flame comes out of a metal tube. The lamp is controlled by a knob, and the glass covering helps to make the flame look brighter.

At first, these lamps burned different kinds of oil for fuel. After 1859, when petroleum became easier to get, people mostly used kerosene. Kerosene is a fuel made from petroleum.

By the early 1800s, many city streets in Europe and the United States were lit by gas lamps. Gas lamps became popular in homes as well.

People used lamps and candles for light for thousands of years.



ancient Egyptian oil lamp

beeswax candle

kerosene lamp

Discovery of Electricity

People have known about electricity for a long time. The ancient Greeks made electrical charges by rubbing pieces of amber with pieces of wool. The first machine to create electrical charges was invented in 1663.

Benjamin Franklin, a famous American inventor, discovered that lightning is really electricity in 1752. It has long been told that he experimented with lightning by flying a kite in a storm. He is said to have tied a key to the kite string near the end he was holding. When Franklin saw a spark jump from the key to his finger, he knew that the sky was full of electrical charges. This experiment was very dangerous. If the kite had been struck by lightning, Franklin could have been killed.

Benjamin Franklin proved that lightning is a form of electricity.

Another scientist who studied electricity was an Italian man named Alessandro Volta. Volta started doing experiments with electric current in 1791. He found out that when two different metals were near each other, electricity would flow from one to the other. This discovery led him to develop the first electric battery in 1800.

Volta's battery was made of alternating copper and zinc disks. These were separated by cardboard disks soaked in salt water. Today, we measure how much electricity a power source makes in volts, named after Volta.

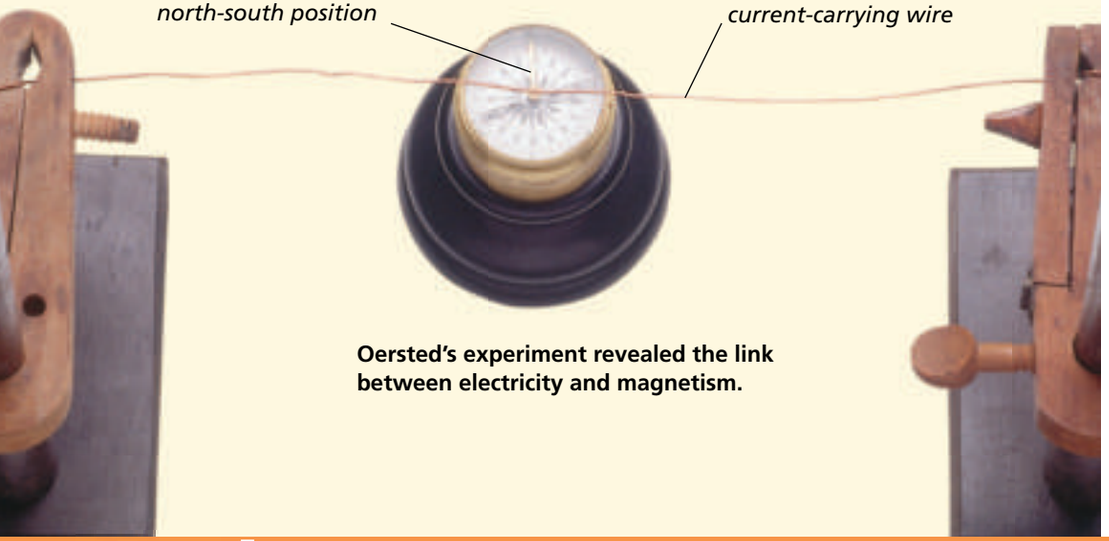
Volta's batteries were made up of thirty to forty pairs of disks.

Electromagnetism

During the early 1800s, many scientists were trying to find a link between electricity and magnetism. In 1820, Hans Oersted, of Denmark, put a compass near a wire carrying an electric current. The needle of the compass moved.

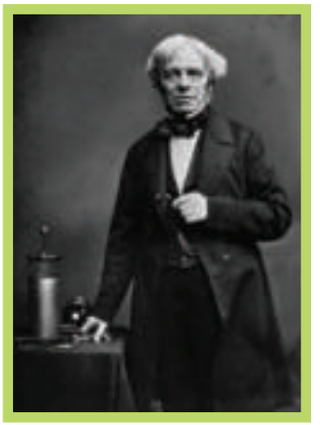
After finding this out, Oersted experimented with stronger current. When he placed a wire above a compass needle and turned on the current, the needle moved in one direction. When he put the wire below the needle, it moved in the other direction. Oersted realized that the electricity in the wire created a magnetic field that moved the needle.

Oersted proved that electricity and magnetism were linked. Many scientists paid attention to Oersted's work, including British scientist Michael Faraday.



Oersted's experiment revealed the link between electricity and magnetism.

Michael Faraday's experiment showed that moving a magnet in and out of a wire coil produces a current in the wire.



Michael Faraday discovered electromagnetic induction.

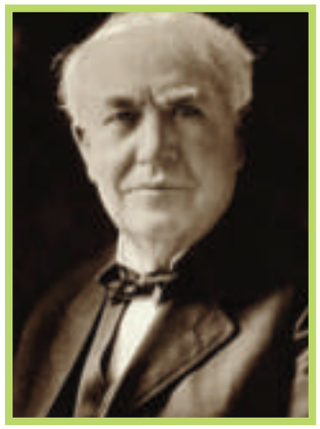
Faraday believed that if an electric current could create a magnetic field, then a magnetic field could create an electric current. In 1831, he tested his idea by wrapping a paper tube with wire to make a coil. Then Faraday moved a magnet back and forth inside the tube. His measurements showed that a current was flowing in the coil. Faraday had discovered electromagnetic induction, the creation of a current by a magnetic field.

Joseph Henry, an American scientist, also discovered electromagnetic induction around the same time as Faraday. Faraday's and Henry's work led to the generators that we use to make electricity today.

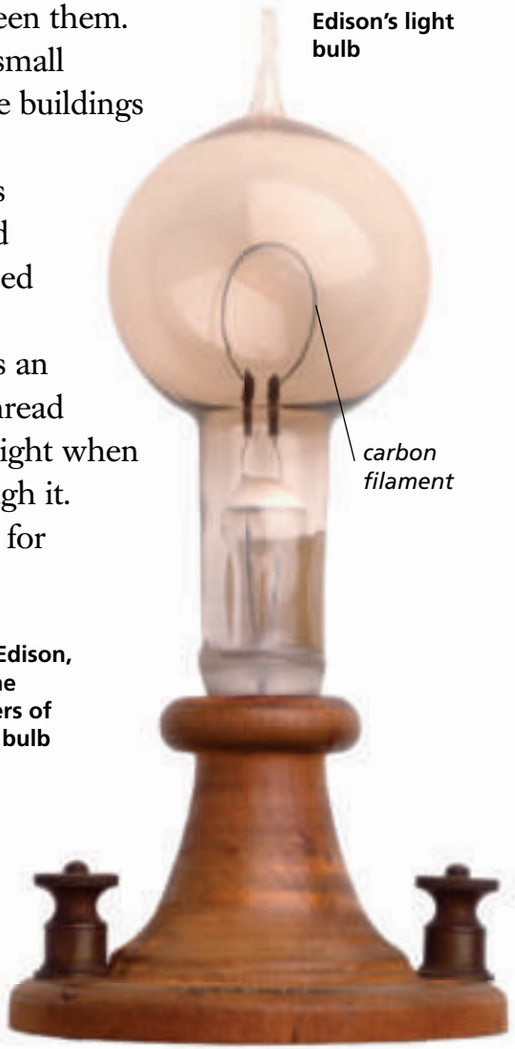
Light Bulbs

People began using electric lighting during the 1870s. The first commonly used electric light was the arc lamp. In an arc lamp, two rods are connected to an electric current. When the rods are held apart, bright sparks jump between them. Arc lamps were too bright for small spaces, but worked well in large buildings or outdoors.

Around 1878, both Thomas Edison in the United States and Joseph Swan in Britain developed the first practical incandescent lamps. An incandescent lamp is an electric lamp. It has a special thread called a filament that gives off light when an electric current passes through it. Incandescent lamps were good for lighting homes.

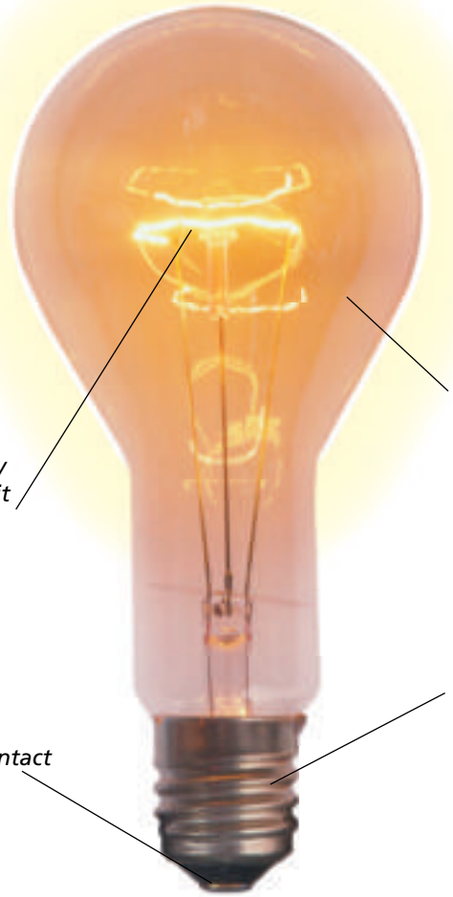


Thomas Edison, one of the developers of the light bulb



Edison's light bulb

Modern incandescent light bulbs are similar to the ones made by Edison and Swan.



The first incandescent light bulbs were made of glass with a carbon filament. The hollow bulbs had no air inside. This kept the filament from catching on fire from the heat of the electricity. The filament glowed when electricity flowed through it. Carbon was not the best material for filaments. If the filament became too hot, it would break quickly.

In 1913, carbon was replaced by the metal tungsten, because it glows brightly and lasts longer at high temperatures. Most of today's incandescent light bulbs use tungsten filaments and are filled with special gases.

New Light Sources

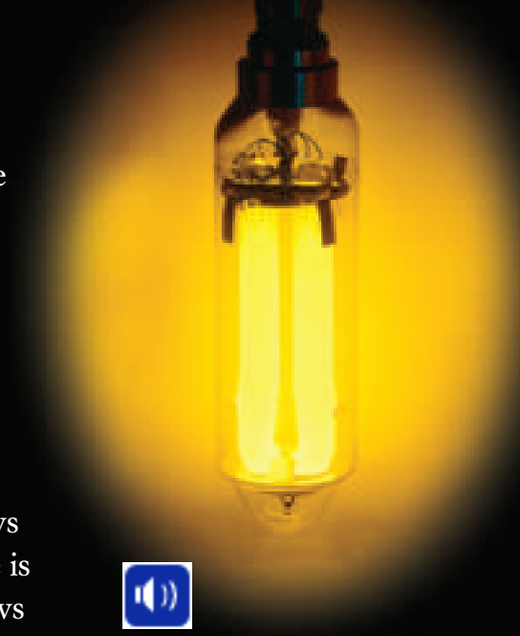
In incandescent lamps, some of the electrical energy is turned into heat instead of light. Discharge tubes were invented to make light without the bulb getting too hot. They use a gas instead of a metal filament. Electricity goes into the tube and causes the gas to glow. This turns less energy into heat and more into light.

Two kinds of lamps that use discharge tubes are neon lights and sodium street lamps. In neon lights, the tube is filled with neon gas. These lights glow bright red. Neon lights became popular for use in signs in the 1920s. Different gases are added to neon to make different colors.

Neon lights are often used to make colorful signs.

Sodium discharge lamps are used for street lights. But they are bad for using inside because of their harsh yellow light.

Another kind of discharge lamp that is becoming more common in homes is the fluorescent lamp. A fluorescent lamp holds vapor that makes invisible rays when a current flows through it. The inside of the tube is coated with a substance that glows when these rays hit it. Fluorescent lights cost more than incandescent bulbs, but they last a lot longer.



Sodium lamps light up streets around the world.

Lasers are devices that make a very concentrated, high-energy beam of light. They cannot be used for lighting. Their light can be so powerful that it can even cut through metal.

Lasers can be used to cut through metal.

Planet of Light

Electric lighting has greatly changed how people live. Light bulbs let us see when it is dark. They are not as dangerous as candles and kerosene lamps. We can shop, watch sporting events, and drive at night.

But a problem with electric lighting is light pollution. Light pollution is light that interferes with our view of the night sky. Scientists are working hard to limit light pollution. They want people and towns to turn off lights they do not need at night and to stop using lights that shine upward. Many places have passed laws that limit light pollution.

Another hazard of electric lighting and electricity is air pollution. Most electricity is generated in power plants by burning fossil fuels. Burning fossil fuels releases pollution into the air. Many scientists believe that this pollution is the cause of global warming. Global warming is a rise in Earth's temperature. It causes climate changes that may be very harmful to plants, animals, and people in the future. Using less electricity and developing cleaner sources of energy are two ways to reduce pollution and global warming.

This image taken from space shows North America's electric lights at night.

Glossary

electromagnetic induction	the production of a current by a magnetic field
fluorescent lamp	a lamp that uses vapor and a special coating to produce light
global warming	the average increase in Earth's temperature, which causes climate changes that may be harmful
incandescent lamp	an electric lamp in which a filament gives off light when heated by an electric current
kerosene	a fuel made from petroleum
lasers	devices which produce a concentrated, high-energy form of light
light pollution	light that interferes with our view of the night sky

What did you learn?

1. What important discovery did Alessandro Volta make?

2. What kind of lighting do many advertising signs use?

3. Why did tungsten replace carbon as a filament for light bulbs?

4. **Writing** in Science Two types of lighting popular today are incandescent and fluorescent lighting. Write to explain the similarities and differences between the two. Include details from the book to support your answer.

5. **Cause and Effect** What happens when a magnet is moved in and out of a wire coil?