

On Level



SCIENCE • GRADE 3

California Content Standards
Physical Sciences: 2.A
Physical Sciences: 2.B
Physical Sciences: 2.C
Physical Sciences: 2.D

# What Is Light?

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FOR:

California's  
Academic  
Content Standards  
Covered

•  
Reproducible  
Student Book

•  
Reproducible  
English-language  
Arts Activities

# What Is Light?

## California's Science Content Standards Met

### GRADE 3 SCIENCE

**PHYSICAL SCIENCES: 2**—Light has a source and travels in a direction. As a basis for understanding this concept:

- a. Students know sunlight can be blocked to create shadows.
- b. Students know light is reflected from mirrors and other surfaces.
- c. Students know the color of light striking an object affects the way the object is seen.
- d. Students know an object is seen when light traveling from the object enters the eye.

### GRADE 3 ENGLISH LANGUAGE ARTS

#### 1.0 WORD ANALYSIS, FLUENCY, AND SYSTEMATIC VOCABULARY DEVELOPMENT

*Vocabulary and Concept Development 1.6*—Use sentence and word context to find the meaning of unknown words.

#### 2.0 READING COMPREHENSION

*Comprehension and Analysis of Grade-Level-Appropriate Text 2.3*—Demonstrate comprehension by identifying answers in expository text.

*Comprehension and Analysis of Grade-Level-Appropriate Text 2.5*—Distinguish the main idea and supporting details in expository text.

*Comprehension and Analysis of Grade-Level-Appropriate Text 2.6*—Extract appropriate and significant information from the text, including problem and solution.

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Physical Sciences: 2.A

Physical Sciences: 2.B

Physical Sciences: 2.C

Physical Sciences: 2.D

# Student Book

*What Is Light?*

Print pages 5 – 18 of this PDF for the student book.

# How to Make the Student Book

- The student book is contained on pages 5–18 of this PDF. It begins on the next page.
- To make one student book, or a two-sided master copy that can be photocopied, you will print on both sides of seven sheets of 8.5" x 11" paper.
- Do a test printout of one book first to familiarize yourself with the procedure.
- Follow these instructions carefully.

## First—Select the Paper

Since you will be printing on both sides of the sheets of paper, select a good quality white paper. We recommend using at least a 22lb sheet.

## Second—Check Printer Settings

Be sure you have the correct page setup settings for your computer and printer. You will print these pages in landscape format.

## Third—Print EVEN Pages

Open the PDF of the book you want to print. Select print from your file menu. In your printer's dialogue box enter pages 5–18 to print. Then select EVEN pages only. It is important to print only the EVEN pages first. Click "Print" to print the even pages. (**Important note:** The first page that prints will be blank. DO NOT discard this page. It will be needed to print the cover in the next step.)

## Forth—Print ODD Pages

When the even pages have printed, flip the stack of pages over to print the odd pages. Place the stack back in your printer. Select print from the file menu again. In your printer's dialogue box, select ODD pages. Click "Print" to print the odd the pages.

## Fifth—Fold the Book

You now have a complete book. Check to be sure the pages are in the correct order with the book's cover as the top page. Then fold the stack of paper in half.

## Sixth—Staple the Book

Use an extended-length stapler to staple the pages together. Place three staples in the spine of the book.

Please note that printers vary in how they output pages. Do a test printing with one book and adjust the procedure as necessary.

If you want to make a one-sided master copy, print ALL pages 5–18 at once. Then select "one-sided to two-sided" on the copy machine.

What Is Light?  
**California's Science  
Content Standards Met**



**GRADE 3 SCIENCE**

**PHYSICAL SCIENCES: 2**—Light has a source and travels in a direction. As a basis for understanding this concept:

- a. Students know sunlight can be blocked to create shadows.
- b. Students know light is reflected from mirrors and other surfaces.
- c. Students know the color of light striking an object affects the way the object is seen.
- d. Students know an object is seen when light traveling from the object enters the eye.

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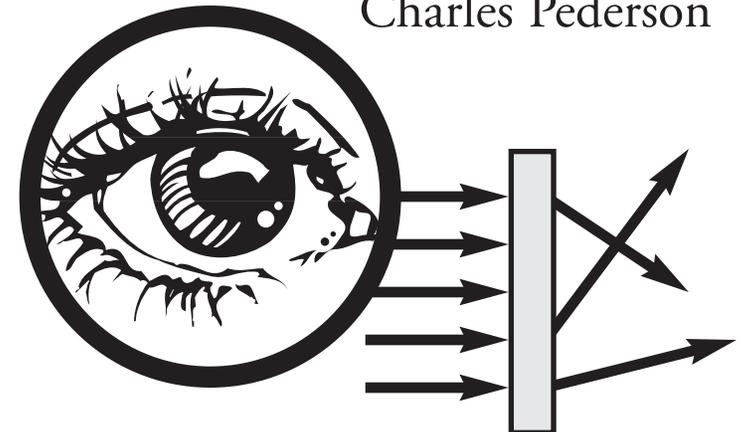
SCIENCE • GRADE 3

California Content Standards

Physical Sciences: 2.A, 2.B, 2.C, 2.D

# What Is Light?

by  
Charles Pederson





SCIENCE • GRADE 3

California Content Standards

Physical Sciences: 2.A, 2.B, 2.C, 2.D

# What Is Light?

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Pederson

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## INTRODUCTION

# Light Lets Us See

You open your eyes in the morning and look around. A fly is sleeping upside down on the ceiling. Outside the window are colorful cars on the street. You wonder what to wear. What colors go together?

Did you ever wonder how you can see these things? Light is the reason. When we see objects, our eyes sense the light bouncing off the objects.

This book is all about light. You will learn what light is. You will find out what light does. You also will read about some people who helped us understand light. When you are done, you will know more about light. You'll be able to tell your friends something new!



*Our eyes can see things because of light.*

## What Is Light?

What is light? Long ago, the ancient Greeks believed it was a stream of particles. They thought these particles flowed like water.

In the 1600s, Christian Huygens developed a **theory** that light was like waves. Huygens thought the waves moved in straight lines, and had tops and bottoms. He believed these light waves could be long or short.

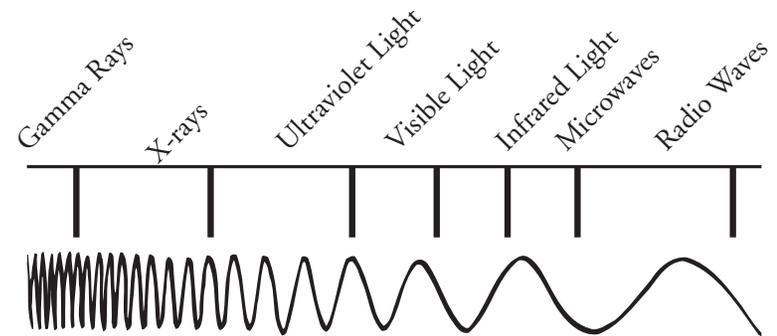
In the 1800s, Thomas Young designed experiments that showed both the ancient Greeks and Huygens were right. Young shined light through two narrow slits in a piece of paper. The light coming through both slits interfered with each other—just like when two waves of water hit and change each other.

**theory:** an explanation that is based on evidence and reason and can be confirmed

Today, we know light is a form of energy that does travel in waves. The kind of energy our eyes can see is visible light energy. This light is part of the **visible spectrum**.

The visible spectrum is made up of light of many colors. When our eyes sense all visible light, we see white light. White light is light without color.

## The Electromagnetic Spectrum



*What can you conclude about these waves by looking at this diagram?*

**visible spectrum:** the light humans can see

## Properties of Light

What causes light? Light is caused by the release of energy from **atoms**.

Atoms can gain and lose energy. When atoms gain energy they become “excited.” One way to excite atoms is to heat them.

For example, when atoms in metal are heated, the excited atoms give off energy. This makes the metal turn red. In red-hot metal, the atoms have enough energy to produce light that we can see.

When the metal gets even hotter, it turns white. This is how a light bulb works. A thin piece of metal in the bulb is heated. This excites the atoms. The atoms then give off energy in the form of white light.

**atom:** a basic unit of matter of which all things are made

---

## Sources of Light

Light comes from two types of sources—natural and artificial. People cannot control natural sources. These include lightning, the sun, and other stars. However, people create artificial light sources. These include such things as candles and electric light bulbs.

Light can be hot and glowing. The sun and many light bulbs **emit** this type of light. Light can also be cool, as with fluorescent lamps, or with fireflies and other objects that glow in the dark.

*Brainstorm a list of other examples of incandescent or fluorescent light.*

**emit:** to send out

---

## Behavior of Light

Light travels in a straight line until it hits an object. It may pass through the object or bounce off the object.

Light that bounces is reflected. Smooth surfaces reflect light waves in one direction. This is why we can see ourselves in a mirror. Rough surfaces reflect light in many directions. The light waves are **scattered**.

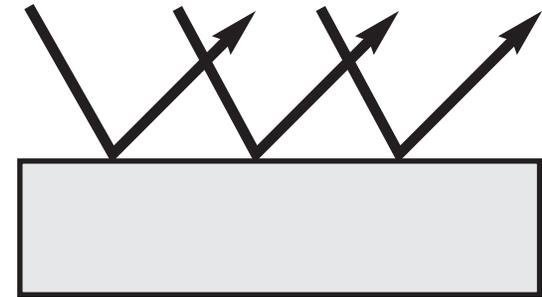
Some objects allow light to pass through, but bends it. The light is **refracted**. Water, for example, slows light down. This causes a pencil to look bent when placed in a glassful of water. Try it.

**Absorbed** light enters an object without reflecting or refracting. Atoms of materials absorb certain colors. The others bounce off, so we see those colors.

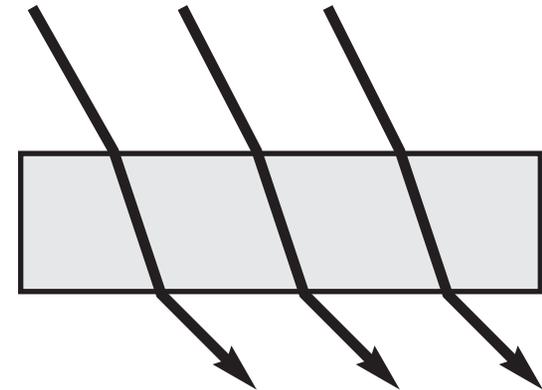
**scatter:** to reflect in many directions  
**absorbed:** taken in and not reflected back  
**refract:** to bend

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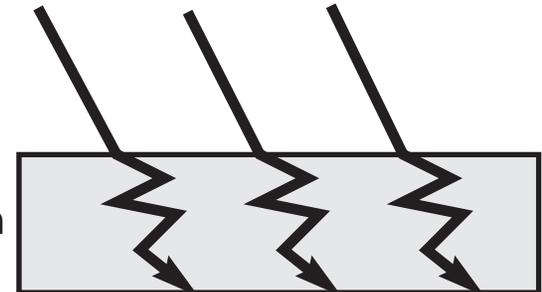
**Reflection**



**Refraction**



**Absorption**



*Look for examples of reflected, refracted, and absorbed light. Summarize your observations in a short paragraph.*

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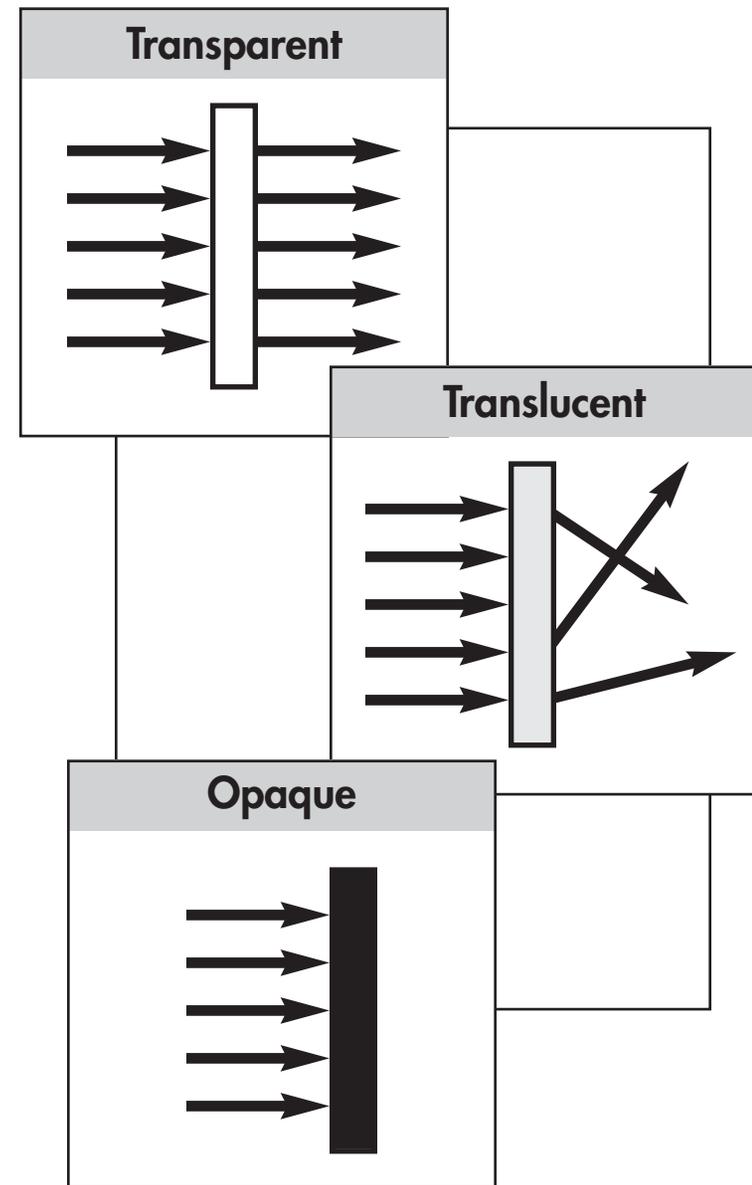
## Materials that Affect Light

Three types of materials affect how we see light. **Transparent** materials allow light to pass through them without mixing or bouncing. We can clearly see an object on the other side of something transparent. Clear glass and plastic are examples of transparent materials.

**Translucent** materials let some light pass through. However, translucent materials scatter the light rays slightly. This causes the images to look blurry. Frosted glass is an example of a translucent material.

**Opaque** materials block or reflect all light. Opaque materials stop light from passing through the material. We cannot see anything on the other side of something opaque. Opaque materials include wood and steel.

**transparent:** allowing light to pass through without mixing  
**translucent:** allowing light to pass through with mixing  
**opaque:** blocking or reflecting all light

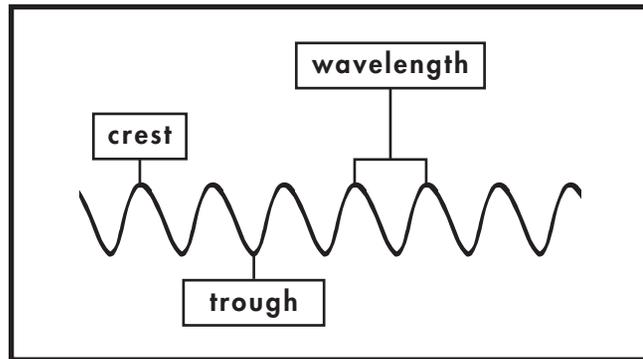


*Name several materials that are transparent, translucent, and opaque.*

## Measuring Light

### Wavelength

Light can be measured according to its wavelength and frequency. Light waves have tops and bottoms, like ocean waves. The tops are called crests. The bottoms are troughs. The wavelength of light is the distance from one wave top to the next.



### Frequency

Frequency is a measure of how many waves pass a point in one second. Frequency is measured in Hertz. It is abbreviated *Hz*.

In the late 1600s, Danish **astronomer** Olaus Roemer showed that light has a speed limit. He observed that Jupiter's moons seemed to disappear behind the planet at different times depending on how far Jupiter was from Earth. His measurements of the speed of light were close but not completely accurate.

In 1926, Albert Michelson measured the speed of light accurately. This American said that in space, light cannot travel faster than 186,282 miles per second.

*Explain why it was important for Michelson to conduct experiments about the speed of light.*

**astronomer:** a person who studies stars, planets and other objects in space

# Optics

## The Study of Light

Hundreds of years ago, Isaac Newton Isaac Newton was a leader in the study and uses of light. Newton asked himself if white light really was white. Or, was there more to it than that?

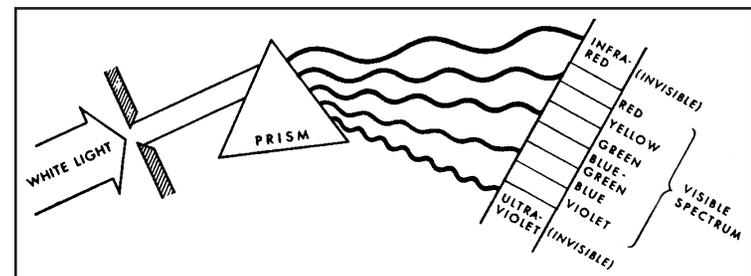
To find the answer, Newton shaded a window. The shade had a hole in it. One beam of sunlight fell into the room through the hole. Newton placed a prism in the sunlight. A prism is a wedge-shaped piece of polished glass. It refracts white light passing through the prism.

---

The refracted light fell on a wall. It looked like a beautiful rainbow. Newton repeated the experiment many times to be sure it was accurate.

The experiment helped Newton decide that white light is not the absence of colors. It is instead the presence of all visible colors.

You can prove this yourself. Shine beams of light through a red, yellow, and blue filter. When the three colors of light combine, the light becomes white.



*A prism splits white light into visible light.*

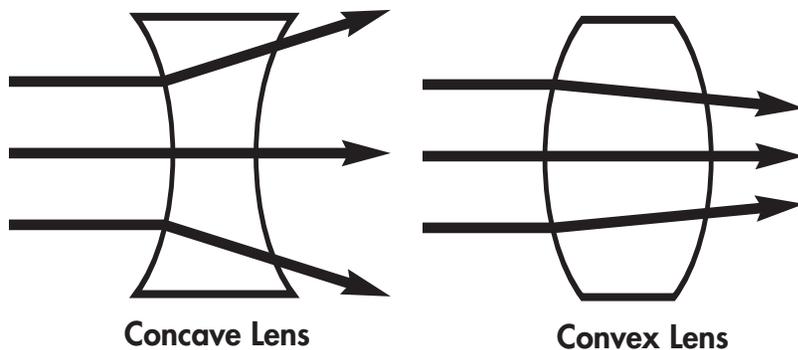
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## Instruments to Study Light

Scientists have created many different instruments to study light. Specially shaped pieces of glass or plastic called lenses are one of the main instruments. A prism is a kind of lens.

Concave lenses curve inward. They have a narrow center and thicker outer edge. Light rays passing through a concave lens refract away from the others. This causes things seen through the lens to look smaller.

The middle of a convex lens curves outward. This causes light rays to refract toward each other, making objects look larger.



*Light refracts when it passes through lenses.  
Concave lenses make things look smaller.  
Convex lenses make them look larger.*

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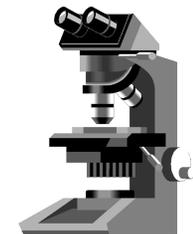
Another early optical scientist was Galileo Galilei.

He used a telescope to study planets and stars.

A telescope has a convex shaped piece of glass. It bends light so users can see faraway objects. Galileo's telescope changed the way people thought about space.



Microscopes are another optical instrument. An optical microscope uses one or more convex lenses to make extremely small objects visible.



Lasers give off thin beams of very powerful light. Lasers have different strengths. Some are delicate enough to perform eye surgery. Some are strong enough to cut through steel. They make people's lives better.

Mirrors are important instruments, too. They reflect light smoothly.

## Light Events

We can see rainbows, optical illusions, and shadows because of light.

### Rainbows

Rainbows occur when light passes through raindrops. Each raindrop acts as a tiny prism. It refracts the sun's white light into its rainbow colors.

### Optical Illusions

Optical illusions are another light event. They trick the eye. They show the difference between what your brain expects and what your eye sees. Look at the two lines below. Is one longer than the other?

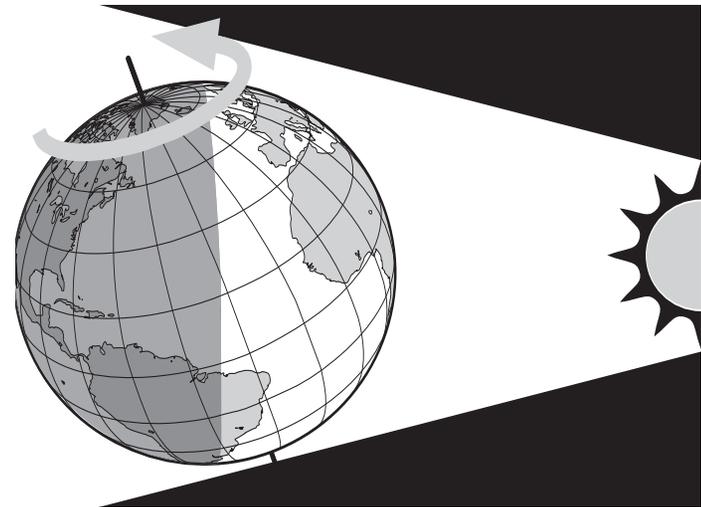


*Optical illusions trick the brain and eyes. If you take a ruler or mark the ends of the lines, you'll see the two lines above are the same length.*

### Shadows

Shadows are caused by the absence of light. When the light strikes an opaque object, the object blocks the light on the other side. This is where the shadow is.

Did you know nighttime is a giant shadow? The opaque Earth blocks the sunlight and casts a giant shadow. The parts of Earth turned away from the sun lie in this shadow.



*Which part of Earth is experiencing nighttime?  
How can you tell?*

---

## Glossary

**absorbed**—taken in and not reflected back

**astronomer**—a person who studies stars, planets and other objects in space

**atom**—a basic unit of matter of which all things are made

**emit**—to send out

**opaque**—blocking or reflecting all light

**refract**—to bend

**scatter**—reflect in many directions

**theory**—an explanation that is based on evidence and reason and can be confirmed

**translucent**—allowing light to pass through with mixing

**transparent**—allowing light to pass through without mixing

**visible spectrum**—the light humans can see

---

## To Find Out More . . .

Want to learn more about light?

### Try these books

*Light* by Darlene R Stille. Child's World, 2005.

*Light: From Sun to Bulbs* by Christopher Cooper. Heinemann, 2003.

### Access these Web sites

See the Light

<http://library.thinkquest.org/13405/index.html>

Optical Research Associates

Optics for Kids: The Science and Engineering Behind It

[http://www.opticalres.com/kidoptx\\_f.html](http://www.opticalres.com/kidoptx_f.html)

### Write for more information

The Exploratorium

3601 Lyon Street

San Francisco, CA 94123

415-397-5673

Museum of Science and Industry

57th Street and Lake Shore Drive

Chicago, IL 60637-2093

773-684-1414

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Comprehension and Analysis of Grade-Level-Appropriate Text: 2.6

# English-language Arts Activities

*What Is Light?*

Print pages 20–24 of this PDF for the reading activities.

# Identify Main Idea

**The main idea is the most important point the author is trying to make. For example, read the following example from *What Is Light?***

What causes light? Light is caused by the release of energy from atoms. When atoms gain energy, they become “excited.” When they lose energy they become “deexcited.” Atoms can either run into another atom to get rid of the energy or they can emit the energy as light.

**The main idea of the paragraph is “The movement of atoms produces light.” Try another one. What is the main idea of the following paragraph?**

Shadows have two parts. The umbra is the darkest part of a shadow. In the umbra, no light falls. But light still acts like waves. The waves leak around the sides of the opaque object. They cause the shadow’s edges to be less dark. This slightly lighter edge is called the penumbra.

**The main idea of the paragraph is “There are two parts to shadows: the darker umbra and the lighter penumbra.”**

**Read the following paragraph from *What Is Light?* Summarize the main idea of the paragraph. Write it on the lines.**

Light comes from two types of sources—natural and artificial. People cannot control natural sources. These include the sun and stars. However, people create artificial light sources. These include such things as candles and electric light bulbs.

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# Context Clues

## TRY THE SKILL

To figure out the meaning of an unknown word, look for words in the same sentence or nearby sentences that give you clues.

Look for word clues in each sentence at the right to figure out which word from the box should complete it. Then write the correct word on the line.

**absorbed:** light that enters an object and does not reflect or refract

**opaque:** blocking or reflecting all light

**reflected:** bounced off a surface

**refracted:** bent

**translucent:** allowing light to pass through with mixing

**transparent:** allowing light to pass through without mixing

**visible spectrum:** the light humans can see

1. I could not see through the wood door because it was \_\_\_\_\_.
2. Li could see the rainbow because it was part of the \_\_\_\_\_.
3. I could see the color of the shirt because the light was \_\_\_\_\_.
4. The pencil in the water looked broken because the light \_\_\_\_\_.
5. I saw myself in the mirror when light \_\_\_\_\_ from it.
6. He could barely see the tree through the \_\_\_\_\_ glass.
7. Jamal could see clearly through the \_\_\_\_\_ glass of the clean window.

# Cause and Effect

## TRY THE SKILL

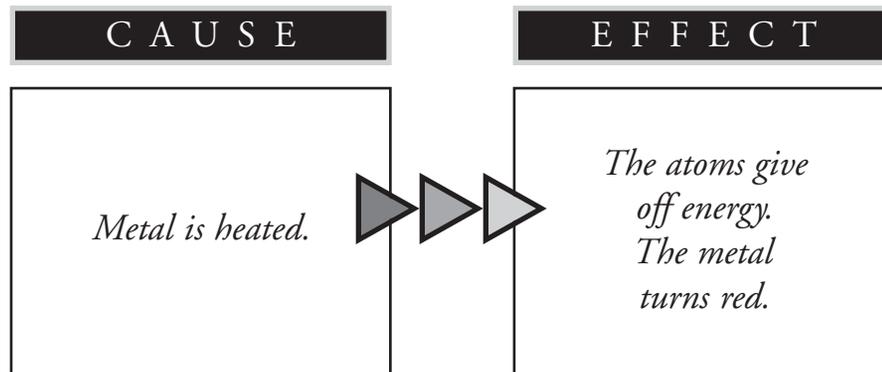
To find out an effect, you ask, “What happened?” To find out a cause, you ask, “Why did that happen?” Identifying causes and effects is a way to better understand what you read. Read this passage from the book:

For example, when metal is heated the atoms of the metal give off energy. It makes the metal turn red.

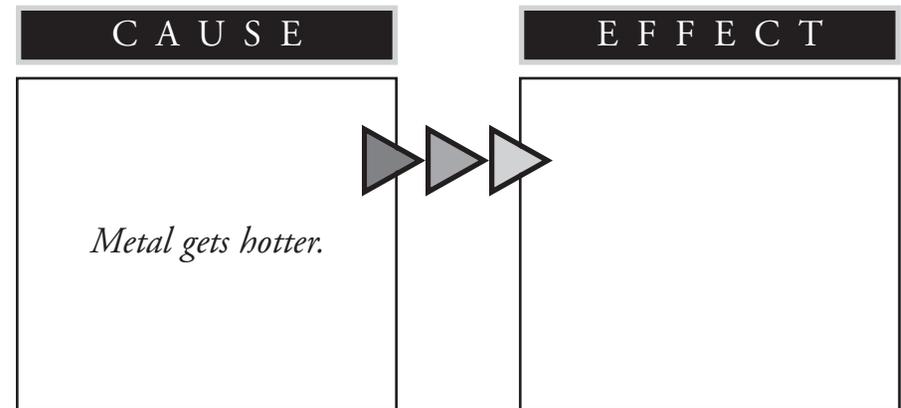
When the metal is very hot, it turns white. Its atoms are very excited and are giving off lots of energy.

When the metal is cooled, its atoms are deexcited. The metal slowly returns to its original color.

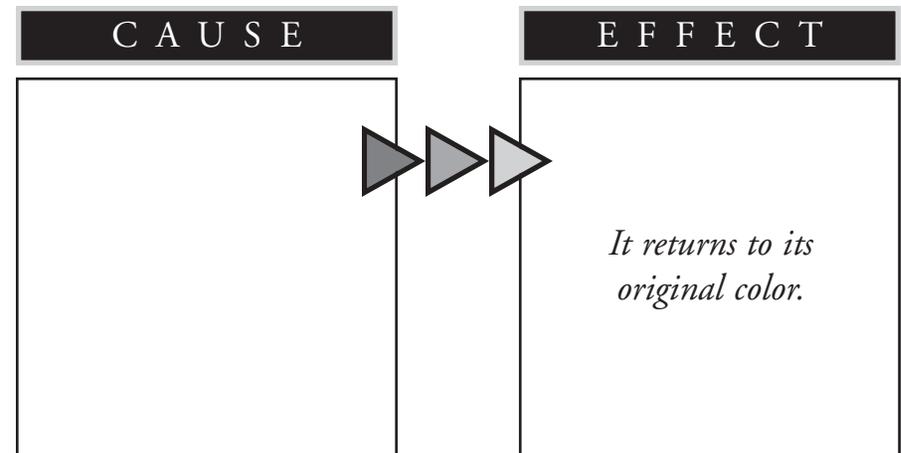
This graphic explains what happened.



Read the passage again. Then complete this graphic. Tell what happens as the metal gets hotter.



Now complete this graphic. Tell why the metal returns to its original color.



# Use Graphic Organizers

## TRY THE SKILL

Graphic organizers help you understand information by taking it out of the text and putting it in the form of a picture. Often, when you see a set of facts, the facts make more sense than when you read them in the text.

Use this organizer to explain how the three different types of materials affect light. Draw a diagram and write a summary about each one.

Transparent	Translucent	Opaque

# Answer Key

## Identify Main Idea

Natural light sources include the sun and stars. Artificial light sources are created by man such as candles and light bulbs.

## Context Clues

1. opaque
2. visible
3. absorbed
4. refracted
5. reflected
6. translucent
7. transparent

## Cause and Effect

**Effect**—It turns white.

**Cause**—Metal cools.

## Use Graphic Organizers

**Transparent** materials allow light to pass through them without mixing or bouncing. We can clearly see an object on the other side of transparent materials. Clear glass or plastic are transparent materials.

**Translucent** materials also let light pass through. However, translucent materials mix up the light rays slightly. This causes the images to look blurry. Frosted glass is an example of a translucent material.

**Opaque** materials block or reflect all light. Opaque materials stop it from passing through the material. We cannot see anything on the other side of opaque materials. Opaque materials include wood and stone.