



Physical Science

Matter and Energy

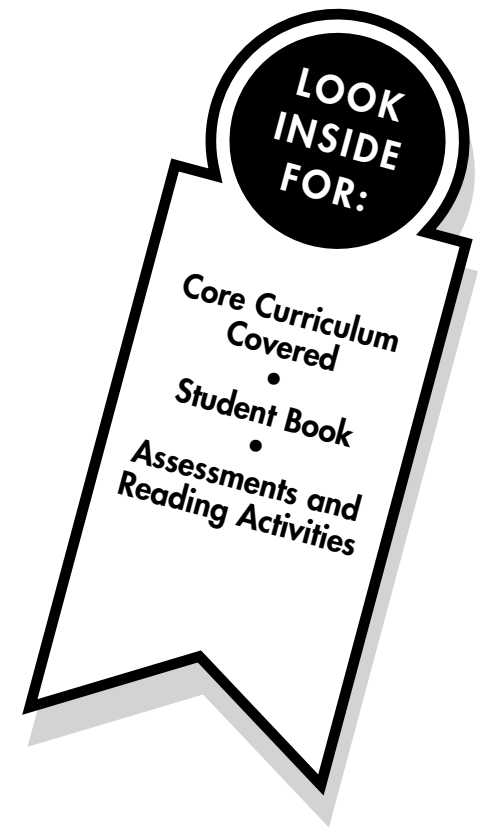
Basic Level

Light Is Energy

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Light Is Energy

What are some ways that energy can be changed from one form to another?

CORE CURRICULUM STATEMENTS

Energy exists in many forms, and when these forms change energy is conserved.

Energy exists in various forms: heat, electric, sound, chemical, mechanical, light.

Energy can be transferred from one place to another.

Some materials transfer energy better than others (heat and electricity).

Energy and matter interact: water is evaporated by the Sun's heat; a bulb is lighted by means of electrical current; a musical instrument is played to produce sound; dark colors may absorb light, light colors may reflect light.

Interactions with forms of energy can be either helpful or harmful.

Basic Level



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Matter and Energy

Student Book

Light Is Energy

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Light Is Energy

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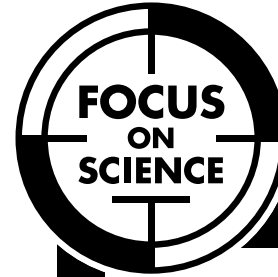
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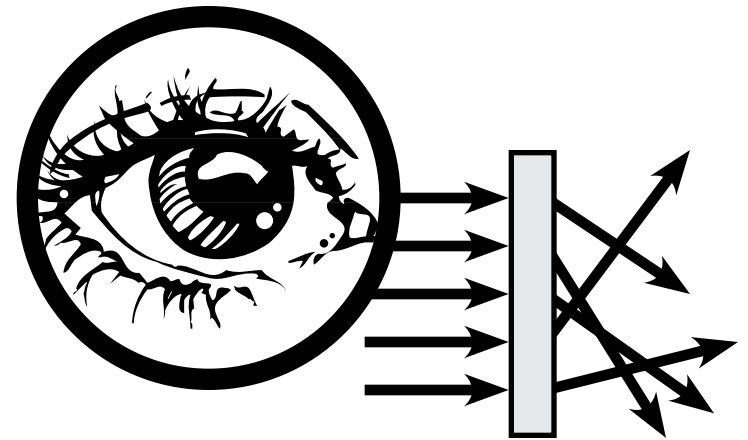


Physical Science

Matter and Energy

Light Is Energy

by
Charles Pederson





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– Predict –

*What do you think you will
learn from this book?*

INTRODUCTION

Light Lets Us See

You see colors everywhere. You see a purple flower with green leaves. You see a red, green, and yellow traffic light.

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

In this book, you will learn about light. You will read about some scientists and their experiments about light. When you are done, you'll be able to tell your friends something new!



Our eyes can see things because of light.

What Is Light?

Long ago, the ancient Greeks believed light 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. He thought the waves moved in straight lines. They had tops and bottoms. They could be long or short.

In the 1800s, a scientist named Thomas Young proved the ancient Greeks and Huygens were right. He proved that light moves in waves similar to how water moves in waves.

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

Today, we know light is a form of energy. Light comes from two sources—natural and **artificial**. Natural light comes from the sun, other stars, and lightning.

People create artificial light. These include such things as candles and electric light bulbs.

The type of light energy our eyes can see is **visible** light energy. Visible light is made up of many colors. We see red when red light bounces off an object.

When our eyes sense light with all the colors, we see white light. Later in the book, you will learn how a scientist proved this.

artificial: made by people, not made by nature
visible: able to be seen

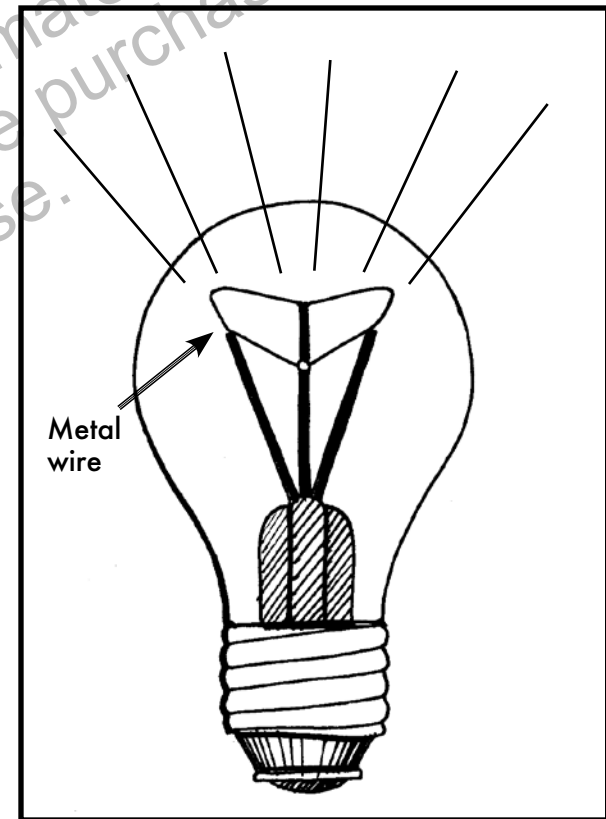
Properties of Light

What causes light? Light is created by the release of energy from tiny particles in **matter**.

For example, when particles in metal are heated, they start to move around. They bump into each other, creating heat. This makes the metal turn red. In a red-hot object, the particles have enough energy to make light that we can see. When the metal is very hot, it turns white.

matter: what all things are made of; anything that takes up space

This is how a light bulb works. Electricity flows through a thin piece of metal in the bulb. The tiny particles in the metal move around and heat up. When the metal gets hot enough, white light is released.

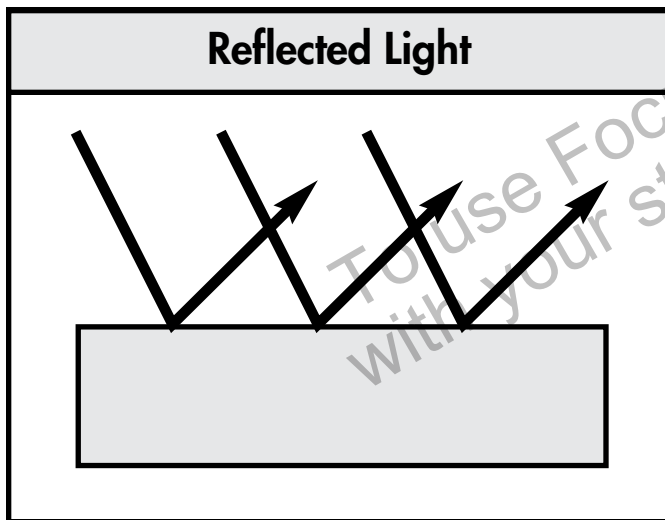


When the wire in a light bulb becomes hot enough, it releases white light.

Behavior of Light

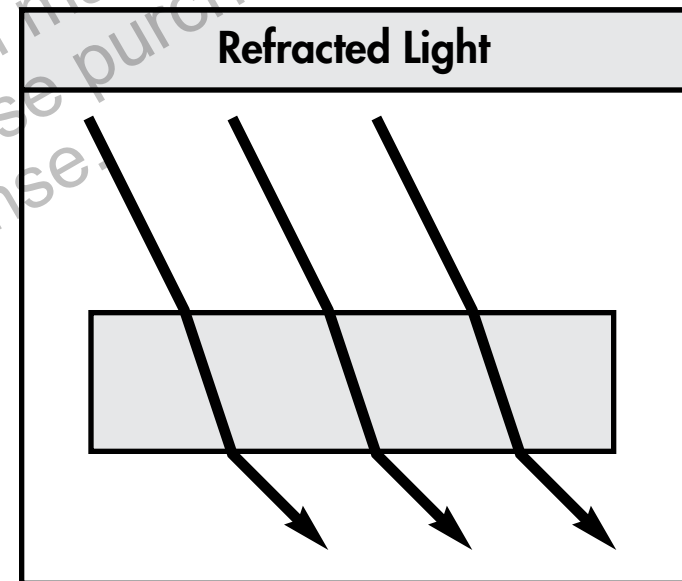
Light travels in a straight line until it hits an object. It may pass through the object, or it may bounce off it.

Light that bounces off an object is **reflected** light. Smooth surfaces reflect light in one direction. This is why we can see ourselves in a mirror.



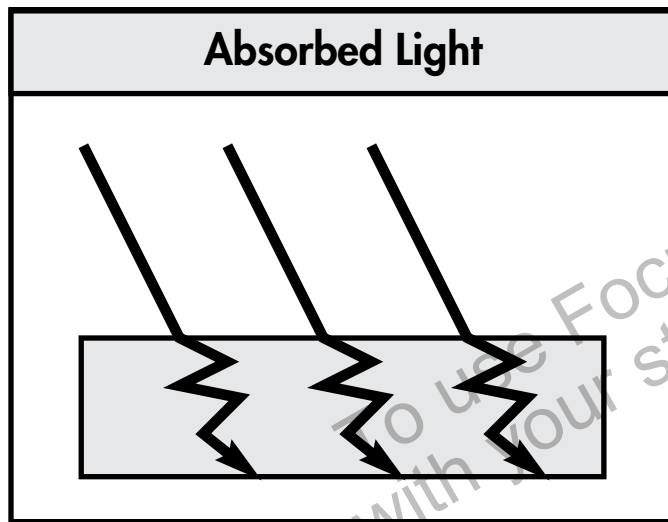
reflected: bounced or thrown back

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



refracted: bent

Light that is **absorbed** enters an object without reflecting or refracting. Tiny particles in objects absorb certain colors. The remaining color or colors bounce off. The colors that bounce off are the ones that we see.

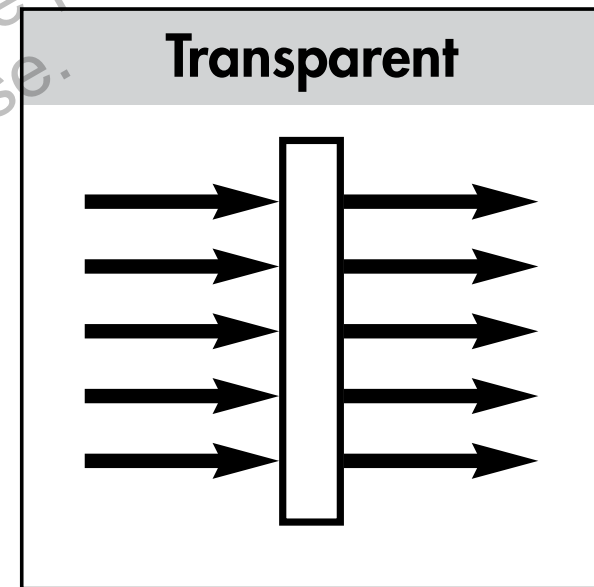


– Describe –
Name some examples of reflected, refracted, and absorbed light.

absorbed: taken in and not reflected or thrown back

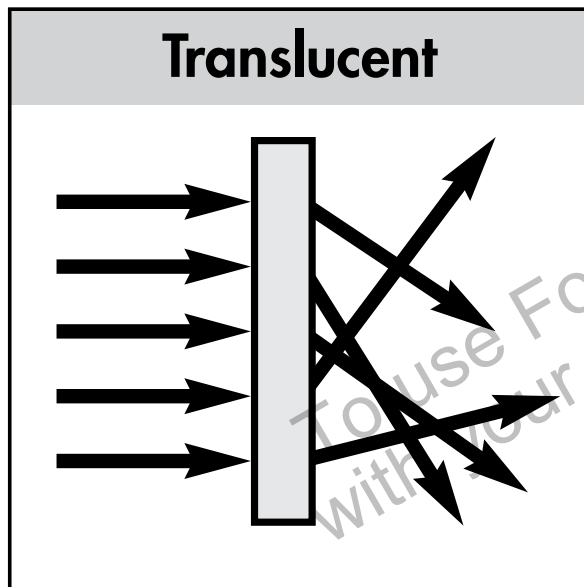
Materials that Affect Light

Three types of materials affect how we see light. **Transparent** materials allow light to pass through them. We can clearly see an object on the other side of transparent materials. Clear glass or plastic are transparent materials.



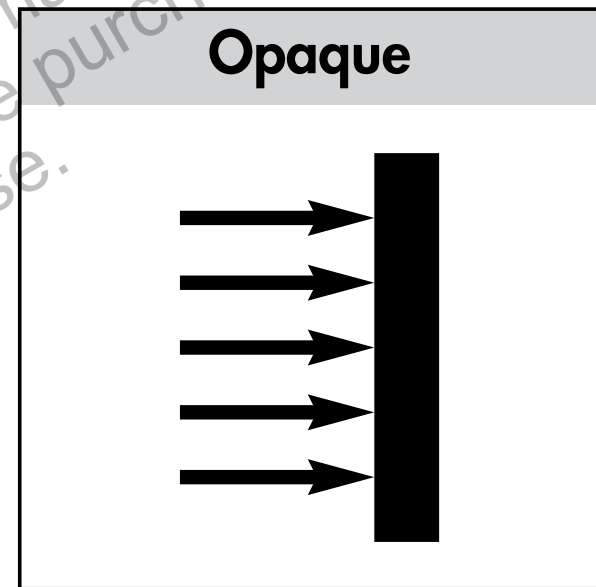
transparent: allowing light to pass through without mixing

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



translucent: allowing light to pass through with mixing

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 steel.



– Transfer –
Name several materials that are transparent, translucent, and opaque.

opaque: blocking or reflecting all light

Optics

The Study of Light

Isaac Newton was a leader in the study of light. He asked himself if white light really was white.

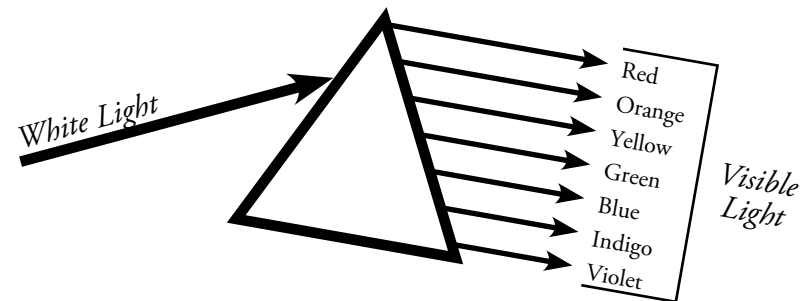
To find the answer, Newton shaded a window. The shade had a hole in it. One beam of sunlight fell into the room through the hole. Newton placed a prism in front of the beam of light. A prism is a wedge-shaped piece of polished glass.

The prism bent, or refracted, the light. The light hit the wall. It looked like a beautiful rainbow. Newton repeated the experiment many times to be sure of the same result.

Newton discovered that white light passing through a prism bends. The prism split the invisible white light into visible colored light.

Newton decided 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.



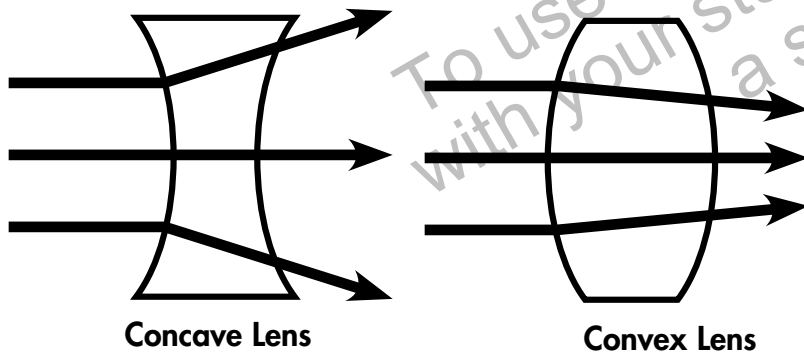
A prism splits white light into visible light.

Instruments to Study Light

Scientists have created many different instruments to study light. One is a lens.

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

The middle of convex lenses 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.*

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. They use one or more convex lenses to make extremely small objects visible.



Light Phenomena

Rainbows

You have seen rainbows on rainy days. Rainbows occur when light passes through the 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 and mark the ends of the lines, you'll see the two lines above are the same length.

Shadows

Shadows are interesting, too. They are caused by the absence of light. Shadows occur when 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.

Glossary

absorbed—taken in and not reflected or thrown back

artificial—made by people, not made by nature

matter—what all things are made of; anything that takes up space

opaque—blocking or reflecting all light

reflected—bounced or thrown back

refracted—bent

scatter—to 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

Write for more information

The Exploratorium

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San Francisco, CA 94123

415-397-5673

Museum of Science and Industry

57th Street and Lake Shore Drive

Chicago, IL 60637-2093

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Basic Level



Physical Science

Matter and Energy

Assessments

Light Is Energy

Print pages 20–22 of this PDF for the assessments.

Check Understanding

Shade the circle next to the correct answer.

1. If you put a pencil in a glass of water, the pencil will appear to be bent. What causes the pencil to appear to be bent?
 - Ⓐ Water causes light to be absorbed.
 - Ⓑ Water causes light to be reflected.
 - Ⓒ Water causes light to be refracted.
 - Ⓓ Water causes light to be transparent.

2. A person is watching television in a room full of light. She wants to darken the room in order to better see the television. What type of material should she put over the windows to darken the room?
 - Ⓐ translucent
 - Ⓑ transparent
 - Ⓒ refracted
 - Ⓓ opaque

Write your answer on the lines provided.

3. Identify **one** example of a transparent material.

Explain what effect the material has on light that hits it.

Check Understanding

Write your answer on the lines provided.

4. Isaac Newton conducted an experiment by shining a beam of white light into a prism. He discovered that the light coming out the other side of the prism was separated into different colors. He repeated the experiment several times.

Explain why Newton repeated the experiment several times.

What theory could Newton propose from this experiment?

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Assessment Scoring Guidelines

1. Answer C is correct.
2. Answer D is correct.
3. A correct response will identify a transparent material such as clear glass and explain that clear glass allows light rays to pass through it.
4. Newton repeated the experiment to be sure he got the same results each time. This let him know what he was observing was true.

White light is made up of all the colors of visible light.

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Basic Level



Physical Science

Matter and Energy

English Language Arts Activities

Light Is Energy

Print pages 24–28 of this PDF for the reading activities.

Summarize Main Ideas

TRY THE SKILL

The main idea is the most important point of a paragraph. All paragraphs should have a main idea.

Read these paragraphs. Try to identify the main idea.

Some objects bend light. It is refracted. Some materials bend light more than others. Water, for example, slows down and refracts light. This causes a pencil to look bent when placed in a glassful of water.

What is the main idea?

Some materials bend light and slow it down.

Try another one. What is the main idea?

Long ago, a Danish scientist proved that light has a speed limit. In 1926 the speed of light was accurately measured. An American scientist measured it. He said that in space, light never can travel faster than 186,282 miles per second.

What is the main idea?

In space, the speed of light is 186,282 miles per second.

To practice determining the main idea, read the following passage. Then write the main idea in your own words.

Today, we know light is a form of energy. Light comes from two sources—natural and artificial. Natural light comes from the sun, other stars, and lightning.

People create artificial light sources. These include such things as candles and electric light bulbs.

What is the main idea of this paragraph?

Roots and Prefixes

TRY THE SKILL

In this book, you learned the meanings of several new words. You can use that knowledge to figure out the meanings of even more words.

Study these prefixes and root words:

trans- is a prefix meaning “across”

Examples: translucent, transparent

re- is a prefix meaning “again or back”

Examples: refract, reflect

vis and vid are roots meaning “see”

Examples: visible, video

opt is a root meaning “eye”

Example: optical

Read the definition. Then shade the circle next to the word it defines.

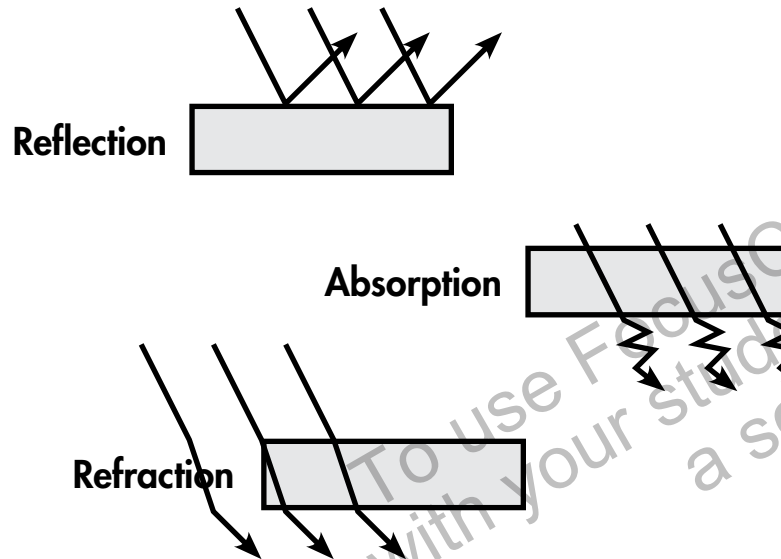
1. A doctor who examines eyes
 - (A) visor
 - (B) optician
 - (C) translate
 - (D) rebate
2. To change something from one language to another
 - (A) rebate
 - (B) optician
 - (C) visor
 - (D) translate
3. A hat worn to help people see in bright sunlight
 - (A) visor
 - (B) optician
 - (C) rebate
 - (D) translate
4. To get money back after you buy something
 - (A) visor
 - (B) rebate
 - (C) translate
 - (D) optician

Interpret Graphics

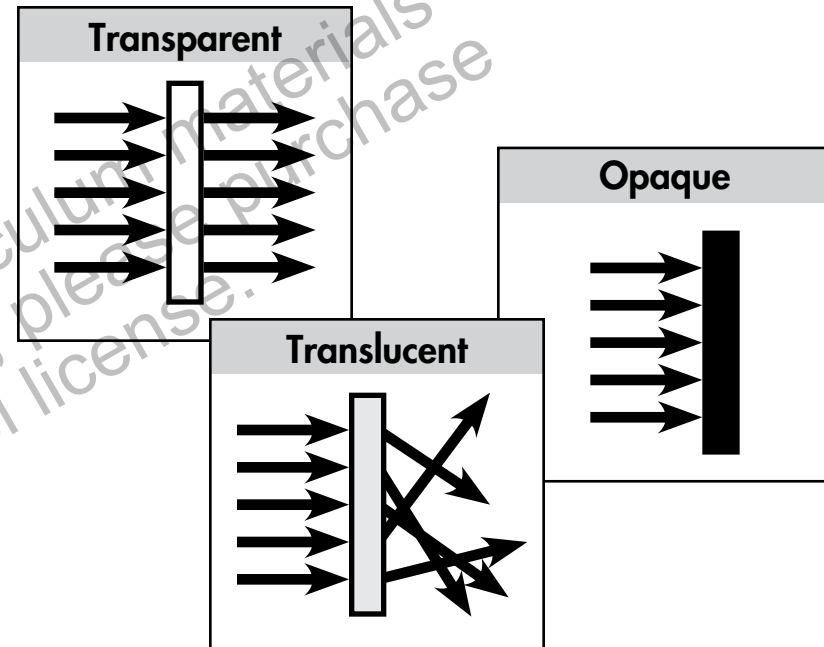
TRY THE SKILL

Graphics can give you information quickly and help you understand how something works.

Look at this graphic showing what happens when light hits different objects.



Study this graphic from *Light Is Energy*. What does it tell you about different types of materials? Write about it.



What does this graphic show you about light?

- Light can reflect or bounce off an object.
- Light can be absorbed and not pass through an object.
- Light can refract, or bend, when passing through an object.

Use a Dictionary

TRY THE SKILL

What should you do if you don't know what a word means or if you do not know how to pronounce a word? You can look in the dictionary.

Read these words from *Light Is Energy*? Draw a line to match each word with its meaning. If you don't know the meaning, look the word up in a dictionary.

Words

1	transparent
2	opaque
3	reflect
4	theory
5	refract
6	translucent

Meanings

A	to bounce off a surface
B	an explanation that can be confirmed
C	allowing light to pass through with mixing
D	blocking or reflecting all light
E	to bend
F	allowing light to pass through without mixing

Answer Key

Summarize Main Ideas

There are two kinds of light energy—natural and artificial.

Roots and Prefixes

1. B
2. D
3. A
4. B

Interpret Graphics

Transparent materials let light pass through them without mixing light rays.

Translucent materials let light pass through them but mix up the light rays.

Opaque materials block or reflect all light.

Use a Dictionary

1. F
2. D
3. A
4. B
5. E
6. C