

Quick Check

Fill in the blank

1. Heat is the flow of energy of moving particles from material to another.
Temperature is a measure of the amount of thermal energy in the moving particles of a substance.

Read a Photo

What is the temperature in Celsius?

24° C

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EXPLAIN

Quick Check

2. A metal object feels cooler than a wood object at room temperature. Why?

Metal is a good heat conductor. A metal object transfers heat away from your hand, making it feel cooler. Wood is a better insulator than metal.

Heat does not transfer to wood as easily as metal.

Quick Check

3. How does heat cause matter to expand?

Adding heat makes the particles move faster and farther apart, so they take up more space.

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EXPLAIN



Heat the flow of thermal energy from a warmer object to a cooler object



Transfer of Heat conduction, convection, and radiation



Heat and Matter expand, contract, change state, or burn

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- 1 **Vocabulary.** The transfer of heat through space is called radiation.

- 2 **Cause and Effect.** What happens when heat is added to ice? To liquid water? To a balloon filled with air?

Cause	Effect
1. heat added to ice	1. temperature increases
2. heat added to liquid water	2. temperature increase and may create steam or boil
3. balloon filled with air	3. balloon expands as it fills with air

- 3 **Critical Thinking.** Explain why heat will not flow from an ice cube to a hot drink.

Heat always moves from warmer things with faster-moving particles to cooler things with slower-moving particles. Ice particles move slower than those in a hot drink.

- 4 **Test Prep.** Many pots and pans are made of metal because:

- metal is a good ☒ conductor
- ☐ insulator
- ☐ heat source
- ☐ radiator

Essential Question

What is heat?
Heat is the transfer of thermal energy from one kind of matter to another. The transfer is always from the warmer to the cooler.

How can you change the sound of a stringed instrument?

Possible answers: by tightening or loosening the strings, by changing the length of the strings, by changing the thickness of the strings.

Essential Question

How can you make sounds?

Possible answer: Sounds can be made by causing vibrations.

In some ways an ocean wave is like a sound wave. A sound wave is a wave that transfers sound through matter. Sound waves spread outward from a vibration in all directions. Unlike an ocean wave, a sound wave does not move up and down.

are pushed and pulled together. Some are spaced apart. The air particles move back and forth. However, they do not change their overall position as they transfer energy.

Quick Check

1. When you pluck a string, it vibrates and makes a sound. How can you stop the sound?

You can stop the sound by stopping the vibrations. This is done by pressing your finger on the string.



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Quick Check

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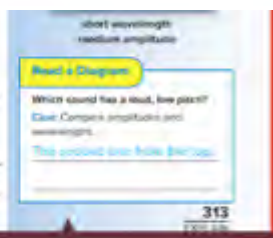


Waves move from high to low volume is low.

Quick Check

- You turn a guitar. On a string makes a sound that is too low. How can you fix this?

The guitar string needs to be tightened.



sound waves.

The Human Ear

When your friend speaks to you, sound waves travel through the air. What happens when those waves reach your ear?

First, the waves carry sound energy to tiny organs in the ear. The energy makes these organs vibrate. The diagram shows how the sounds move from the ear to the brain. All these steps happen in an instant!

The nerve carries these signals to the brain. The brain interprets the signals as sound.

Quick Check

- Why can't sound travel through outer space?

Sound is almost a vacuum. There is no matter to carry sound energy effectively.

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Quick Check

- Why doesn't sound travel well in air?

Sound travels better in water and solids than in air.



How Sound is Produced Possible answer: Sound

is produced when particles vibrate. Sound waves carry energy away from the source of the vibration.



How Sound Travels Possible answer: Sound

travels through solids, liquids, and gases.

Reflected sounds are called echoes.



Characteristics of Sound Possible answer: The

characteristics of sound include frequency, pitch, amplitude, and volume.

Think, Talk, and Write

- Vocabulary.** The highness or lowness of a sound is its pitch.

- Inter.** Latrelle is at a concert. She must shout to be heard by her friend. What do you know about sounds and hearing? About loud noises? What can you infer about the sounds at the concert?

Clues	What I Know	What I Infer
Music is so loud. Latrelle must shout to be heard.	Loud music is harmful to hearing.	Latrelle may damage her hearing unless she wears earplugs.

- Critical Thinking.** A guitarist loosens one string and then tightens another. Why?

By loosening and tightening the strings, the guitarist changes the strings' frequencies of vibration, which changes their pitch. Loosening a string lowers the pitch; tightening a string raises pitch.

- Test Prep.** A sound wave with high amplitude produces which kind of sound?

A high B low C loud D fast

Essential Question How do people obtain and use water?

Sounds can be made by causing vibrations.

Solve It

Write and solve a multiplication sentence for each problem.

- You shout in a canyon. Your echo returns 2 seconds later. How far away is the canyon wall?

340 meters ($2 \times 340 / 2 = x$)

$x = 340$ m

- In the ocean, sound travels at 1,500 m/s. A ship's sonar signal returns in 3 seconds. How far away is the ocean floor?

2250 meters ($3 \times 1500 / 2 = x$)

$x = 2250$ m

Problem Solving

- Read the problem carefully.

What do you know? (The time was 1 second. The speed of sound is 340 m/s. The sound makes a two-way trip.)

What do you need to find out? (the distance)

- Decide whether to use addition, subtraction, multiplication, or division.

Write a number sentence and solve it. $1 \times 340 \text{ m/s} \div 2 = x$
 $x = 170$ m

- Check to see that your answer makes sense.

Have you ever seen a rainbow in the sky? Rainbows are made of light. How do they form? Why do they have different colors?

When white light, which contains all colors, passes through raindrops

in the atmosphere, the light is split to the spectrum of colors.

The same thing happens when white light passes through a prism.

Essential Question How does light behave?

Light behaves as a wave that travels in a straight line and can be reflected, refracted, or blocked.

What is light?

You live in a world full of color. Look around. All the colors you see are part of light. Light is a form of energy we detect with our eyes. It comes from the Sun, lightbulbs, fire, and other sources. It can even come from living things like fireflies!

Newton's Prism

In the mid-1660s, young Isaac Newton wanted to learn about light and colors. One sunny day, Newton darkened his room. He made a small hole in his window shutter. The hole was just big enough for a beam of sunlight to shine through.

Newton then held a glass prism in the sunbeam. A **prism** is an object that separates white light into bands of colored light. With his prism, Newton saw all the colors of the rainbow!

The Visible Spectrum

Newton was the first to show that white light is made of all the colors we can see. These colors make up the visible spectrum.

We now know that the visible spectrum is not the only part of light. Like sound, light travels in waves. The **electromagnetic spectrum** is the range of waves that make up light. Where is visible light in the electromagnetic spectrum? Look for it in the diagram below.

Quick Check

1. What is the electromagnetic spectrum?

It is the range of

energy waves that

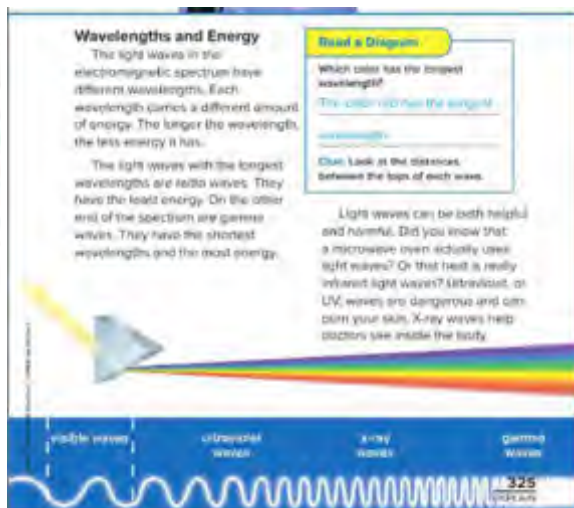
include visible light.

It includes waves ranging

from gamma waves

to microwaves and radio

waves.



How Mirrors Work

Like a lens, a mirror can be convex or concave. A **convex mirror** spreads out the reflected light rays. This gives a wide view of the reflected image. For this reason, convex mirrors are often used as rearview mirrors in vehicles.

Concave mirrors focus the reflected light rays together at a point. What you see depends on how close you are to the mirror. The toy penguin appears larger when it is close to the mirror. It appears upside down when it is far from the mirror.

The Law of Reflection

When light reflects off a surface, it changes direction. The light rays moving toward the surface are called **incoming rays**. The reflected light rays are called **outgoing rays**.

Incoming rays strike a surface at an angle called the **incoming angle**. Outgoing rays reflect at an angle called the **outgoing angle**. The incoming and outgoing angles are always equal. This relationship is called the **law of reflection**. It is shown in the diagram.

Quick Check

2. What is reflection? How does light reflect?

Reflection is when an object

hits a surface and bounces off.

Light reflects off a surface. The

incoming rays are equal.

3. Compare convex and concave mirrors. How are they different? Answer?

A convex mirror always

diverges light rays.

Concave mirrors focus light rays.

Convex mirrors are used in

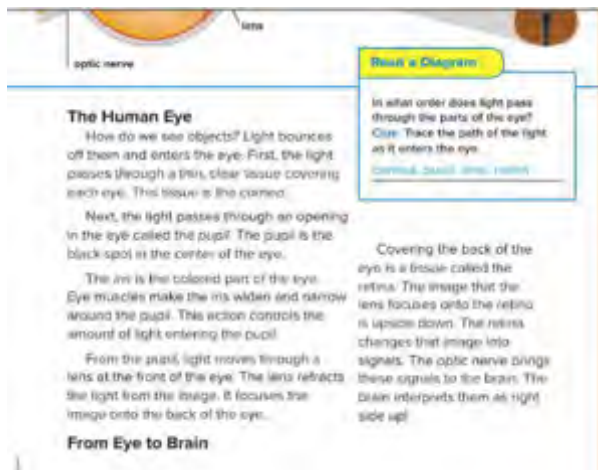
rearview mirrors.

Concave mirrors focus light rays

at a point, giving different

images depending on the

object's position.



Visual Summary

Complete the lesson summary in your own words.



Light: Possible answer: A form of energy that travels in waves. We can use the electromagnetic spectrum to classify it.



Refraction: Possible answer: The bending of light as it passes from one material to another.



Reflection: Possible answer: Occurs when light strikes a surface and bounces off of it. Some surfaces block light completely.

What can light pass through?

When light shines on an object, it may or may not pass through.

Transparent Objects

Some materials are **transparent**. They allow light to pass through in a straight line. Light travels in a straight line through air, water and outer space. You can see through them clearly.

Translucent Objects

Translucent materials scatter light in different directions. It is hard to see through them clearly. Some shower doors are made of translucent plastic. This cloudy material offers some privacy.

Opaque Objects

For total privacy, people use **opaque** materials. Opaque materials block light completely. Wood and metal are opaque. So is this textbook.

How do you know whether an object is opaque? Hold it in front of a light source. If no light passes through, then the object is opaque.

Quick Check

4. You are designing a window that protects people's privacy. What material would you use? Explain why.

A translucent material such as

cloudy plastic. This would allow

light to pass through in the room,

but people would not be able to

see through it clearly.

2 Main Idea and Details. How do lights help the eye see objects? Support your answer with details.

Main Idea	Details
Light is a form of energy that radiates from the Sun, fires, light bulbs, and other sources.	Light can be reflected with mirrors and refracted with lenses and prisms. The color of an object depends on the color of light that the object reflects.

3 Critical Thinking. How is refraction similar to reflection?

In both, light rays change direction. In reflection, light rays strike and bounce off an object at an equal angle. In refraction, light rays are bent when passing from one material to another.

4 Test Prep. Light cannot pass through a(n) _____ object.

- ☐ A transparent ☐ C translucent
☒ B opaque ☐ D convex

5 Test Prep. Which light has the most energy?

- ☐ A radio waves ☒ C gamma waves
☐ B x-rays ☐ D microwaves

Essential Question How is water recycled?

Light behaves as a wave that travels in a straight line and can be reflected, refracted, or blocked.

4 In time, the charges move around. The balloon becomes neutral. It is no longer attracted to the wall, so it falls.

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What happens if you hold a negatively charged balloon near a wall? It repels the wall's negative charges. It also attracts the positive charges in the wall. This pull makes the balloon stick to the wall. Over time the charges move around. The balloon becomes neutral and falls.

Quick Check

1. Plastic wrap tends to accept negative charges. What would happen if you rubbed a balloon with plastic wrap?
 The plastic wrap would be attracted to the balloon.

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EXPLAIN

negative or positive.

The charges keep building until you touch something. Then they move to whatever you touch. This fast movement of charge is called a **discharge**. You might feel the discharge as a small **shock**. You might even see or hear it.

Lightning

Not all discharges result in small shocks. **Lightning** is the discharge of static electricity during a storm. Inside a storm cloud, ice and water droplets

of electrical charges is known as an **electric current**.

Quick Check

2. How is current electricity different from static electricity?
 Static electricity does not have moving charges. Current electricity has flowing electrical charges.



Light is on.

Read a Diagram

What happens to the circuit when the switch is on? What happens to the light?

The circuit is closed, or complete; the light is on.

Clue: Trace the path of the circuit in each flashlight.

Electrical outlets in most homes are connected in parallel circuits. You turn off one electrical device in a room, and others stay on. If the outlets were connected by a series circuit, all the electricity would turn off at once!

Quick Check

3. A parallel circuit has two lightbulbs. One of them burns out. What happens to the other bulb?

The other lightbulb remains lit.

Read a Diagram

How is a parallel circuit different from a series circuit?

Clue: The arrows show the flow of current electricity.

In a parallel circuit, the current has more than one path through which it can flow; in a series circuit, there is just one path. If a part is removed, a parallel circuit will continue to work, but a series circuit will not.

Quick Check

4. In new buildings, circuit breakers are used more often than fuses. Why?

Fuses can be used only once, but a circuit breaker can be reused.



Static Electricity: The buildup of charged particles on the surface.



Current Electricity: The flow of electrical charges through a circuit.



Electrical Circuit: The path along which electric current flows.

Think, Talk, and Write

- Vocabulary.** The path that electricity can flow through is called a(n) circuit.
- Draw Conclusions.** Shamsa plugs in an electric heater. All the appliances in the room shut off. Why? What should she do?

Text Clues	Conclusions
In a series circuit, electric current flows in the same direction along a single path. Charges do not flow through a series circuit when one is removed.	The space heater overloaded the series circuit. Shamsa should have an adult check the circuit breaker or fuse box, then plug the heater into a different outlet.

- Critical Thinking.** If you add lightbulbs to a series circuit, the circuit has more resistance. What happens to the electric current in the circuit?

Less electric current will flow through the circuit.

- Test Prep.** Which has separate paths connecting each load to its power source?

- A** a short circuit **C** a series circuit
B a circuit breaker **D** a parallel circuit

Essential Question How does electricity affect your life?

Electricity gives my home light at night and runs my TV.

produce light.
 ikes the gas glow.
 do not become as
 nt bulbs.

Quick Check

1. Electric current flows through a bulb's filament. What happens next?

Resistance in the filament converts
 some of the electrical energy into
 heat, and the filament heats up.

When the filament becomes hot
 enough, some of the electrical
 energy is converted into light.

◀ This is an
 incandescent light.
 Flame

◀ This is a
 fluorescent light.

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 EXPLAIN

Heat	Light	Motion
Electrical energy can be converted to heat. It can be used to cook food and dry clothes. Some furnaces use electrical energy to heat homes.	Electrical energy is used to light buildings, vehicles, and streets.	Electric motors change electrical energy into motion. Electric motors are found in toys, washing machines, drills and other tools.

2. Critical Thinking. Suppose an incandescent light bulb and a fluorescent light bulb produce the same amount of light. The incandescent bulb uses more energy. Why?

The incandescent bulb produces a large amount of heat in addition to the light. A fluorescent bulb produces very little heat in addition to the light.

3. Test Prep. Which changes electrical energy into motion?

A a paper airplane B an electric fan
 C a toaster D a lamp

4. Essential Question. How is electricity helpful to people?

People use electrical energy by converting it into heat, light, or motion.

Visual Summary

Summarize the following terms in your own words.



Electrical Energy Conversion: Electrical energy can be converted to other forms of energy, such as light, heat, and motion.



Incandescent Light: produces heat and light. Inside is a thin wire called a filament. As the filament resists electric current, it heats up and glows.



Fluorescent Light: Uses gas to produce light. Electric current makes the gas glow. Fluorescent bulbs do not become as hot as incandescent bulbs.