FOCUS ON SCIENCE

Energy Waves

Advanced Level

Physical Science
Interactions Between Matter and Energy

FOCUScurriculum

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Scientific Inquiry

The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.

Represent, present, and defend their proposed explanations of everyday observations so that they can be understood and assessed by others.

Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.

Use conventional techniques and those of their own design to make further observations and refine their explanations, guided by a need for more information.

Physical Science

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

Different forms of electromagnetic energy have different wavelengths. Some examples of electromagnetic energy are microwaves, infrared light, visible light, ultraviolet light, X-rays, and gamma rays.

Light passes through some materials, sometimes refracting in the process. Materials absorb and reflect light, and may transmit light. To see an object, light from that object, emitted by or reflected from it, must enter the eye.

Vibrations in materials set up wave-like disturbances that spread away from the source. Sound waves are an example. Vibrational waves move at different speeds in different materials. Sound cannot travel in a vacuum.

Electrical energy can be produced from a variety of energy sources and can be transformed into almost any other form of energy.

English Language Arts

The following is a selective listing of the competencies and indicators addressed in this book.

Word Recognition

- Use word recognition skills and strategies quickly,accurately, and automatically when decodingunfamiliar words

Background Knowledge and Vocabulary Development

- Use self-monitoring strategies to identify specific vocabulary difficulties that disrupt comprehension,and employ an efficient course of action, such asusing a known word base or a resource such as aglossary to resolve the difficulty

Comprehension Strategies

- Use a variety of strategies (e.g., summarizing,forming questions, visualizing, and making connections) to support understanding of texts read

Energy Waves

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How to Help Your Students Make the Best Use of This Book

Encourage students to develop nonfiction literacy skills by completing the Active Reader activities. Also encourage them to . . .

- Underline main ideas in paragraphs.
- Circle details that support the main ideas.
- Write down questions as they read.
- Circle key words as well as unfamiliar words.

Printing Instructions

Student Book: print pages 5–24

Assessments: print pages 25–28

Answer Key: print pages 29–30

FOCUS ON SCIENCE

Energy Waves

How do the properties and interactions of matter and energy explain physical and chemical change?

Energy cannot be created or destroyed. It just changes from one form to another. For example, the potential energy of a stretched rubber band becomes kinetic energy when the band is released to fly through the air.

Energy can travel from one place to another. For example, sound waves travel through air or water as sound energy is transferred from one particle to its neighbor. Seismic waves cause the ground to vibrate as they pass through after an earthquake. But in outer space, where there is no matter, energy waves can travel without the help of matter.

Energy Waves

Table of Contents

Starting Points

Chapter 1 What Are Energy Waves?

Chapter 2 Measuring Energy Waves

Chapter 3 Light Waves

Starting Points

Build Background

Brainstorm

How many different kinds of waves are you familiar with? List as many kinds of waves as you can on the lines below. Then, look for these words as you read this book. If you find the name of a wave you listed below, come back here and circle it. After you have completed this book, come back and add to the list.

____

____

____

Define

What do you already know about kinetic and potential energy? Write your own definitions for the terms ***kinetic energy*** **and** ***potential energy.***

1. **Kinetic energy is** ____

2. **Potential energy is** ____

Explain

Write a few words explaining the differences between kinetic and potential energy.

____

____

Starting Points

Key Vocabulary

Rate Your Knowledge

The words listed below have to do with energy as it relates to waves. Each word is important, but some of them may be new to you. Rate your knowledge of each one by checking the appropriate column. Give the definition, if you know the word. After completing this book, come back to this page and write the definitions of words you did not know.

	I don't know it.	I've seen it, but I'm not sure what it means.	I know it well, it means...
decibels			
electromagnetic spectrum			
energy			
fault			
focus			
medium			
oscilloscope			
pitch			
wavelengths			

Use Roots to Unlock Meaning

Many science words come from Greek or Latin. Knowing Greek and Latin roots can help you unlock the meaning of many science terms. Circle the word in each sentence that contains the root.

-graph

1. I asked the baseball player for his autograph.
2. Several of the photographs are on display at the museum.

-scope

3. The high-powered telescope will allow us to view Jupiter.
4. The doctor's stethoscope hung loosely around his neck.

electr-

5. Electricity to the house was cut off when a tree fell across the power lines.
6. An electrician was called to install the wiring in the new house.

Key Concepts

Energy Waves

Energy waves are all around us. Energy travels from place to place by waves. Energy waves can move up and down or back and forth. **Transverse** waves move up and down. **Longitudinal** waves move back and forth.

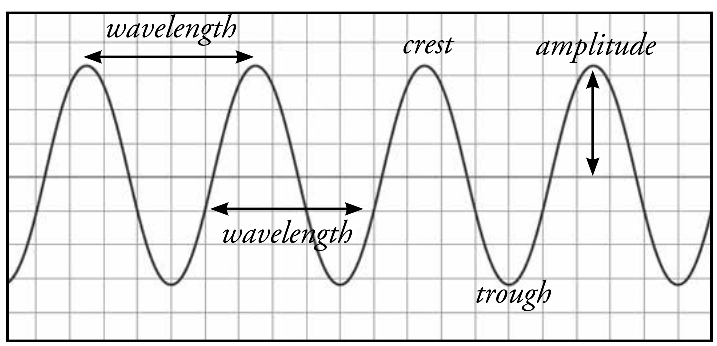
All waves cause the particles in a medium through which they are traveling, such as water or air, to vibrate. Although waves move through the medium, the particles themselves do not move along with the wave. The particles may move up and down or bounce into each other, but once the wave has passed, they return to their previous state.

Think of a cork bobbing up and down in the sea as a wave passes by. It will bob up and down, but it won't travel toward the beach along with the wave.

Parts of a Wave

The highest point of a wave is called its **crest**. The lowest point in a wave is called the **trough**. The distance between two waves is called the **wavelength**. The distance between the crest and the trough of a wave is twice the **amplitude**.

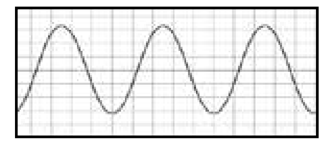
A wave with high amplitude has more energy than a wave with lower amplitude. Think of an ocean wave, the higher the wave, the stronger the force it hits you with. A large wave could knock you over, but a smaller wave will do little more than get you wet. Scientists also measure the number of waves that pass a certain point during a certain span of time. This number of waves is called **frequency**. Scientists use all three measurements—wavelength, amplitude, and frequency—to compare waves.

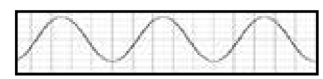


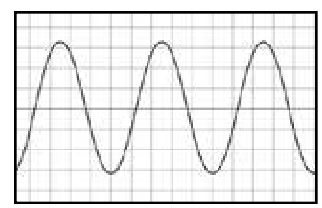
Scientists measure the wavelength, amplitude, and frequency of a wave.

ACTIVE READER

1 Identify *The higher the amplitude of a wave the more energy it has. Number the waves below in order of how much energy they have: 1 being the least energy and 3 being the most.*

____ 

____ 

____ 

Hands On Science

Watch Waves

Using a jump rope, demonstrate how waves can be measured.

1. **Tie one end of the jump rope to a chair and hold onto the other end. Shake the rope vigorously up and down. Record the properties of the wave. Draw a picture of it at the right.**

   Type of Energy Wave: ______________________________

   High or Low Amplitude: ______________________________

   High or Low Frequency: ______________________________

2. **Keeping the jump rope tied to a chair, now move the rope back and forth slowly parallel to the ground, like a snake. Record the properties of the wave. Draw a picture of it at the right.**

   Type of Energy Wave: ______________________________

   High or Low Amplitude: ______________________________

   High or Low Frequency: ______________________________

3. **With the jump rope still tied to the chair, move the rope slowly up and down. Record the properties of the wave. Draw a picture of it at the right.**

   Type of Energy Wave: ______________________________

   High or Low Amplitude: ______________________________

   High or Low Frequency: ______________________________

Chapter 1 What Are Energy Waves?

FOCUS

The underlined sentence states an important idea about energy waves. As you read, discover how waves behave.

Energy Waves

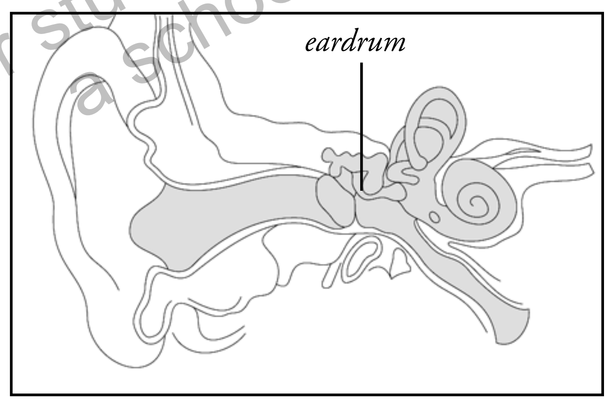
Many different kinds of energy use waves to get from one place to another. When most people think of waves, they picture ocean waves crashing against the shore. Although ocean waves do carry a tremendous amount of energy, they are not the only kind of wave. In fact, most waves are not visible to the naked eye.

Sound Waves

Sound waves are produced by vibrations. For example, when a musician bangs on a drum, the banging makes the skin of the drum vibrate. These vibrations are carried through the air to your ears. The sound waves cause your eardrums and other parts of your ears to vibrate. Your brain identifies these vibrations as sound.

To travel, sound waves need a medium, such as air or water. Although the sound waves travel through a medium, the medium itself does not move along. Waves carry energy along, but not mass. The more dense a medium is, the slower waves will travel as they pass through.

Without a medium, there would be no sound. When astronauts are in space, where there is no air for sound waves to travel across, they must use radios in their helmets to talk to each other. Sound waves can travel faster in some mediums than in others.



Just like a drum vibrates when struck with drumsticks, your eardrum vibrates when sound waves hit it.

ACTIVE READER

1 Infer *Which medium would transmit the sound made by banging on a drum faster: water or air? Why?*

____

____

____

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2 Connect *Tell about a time you experienced a really loud sound. How did it make your ears or head feel?*

____

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____

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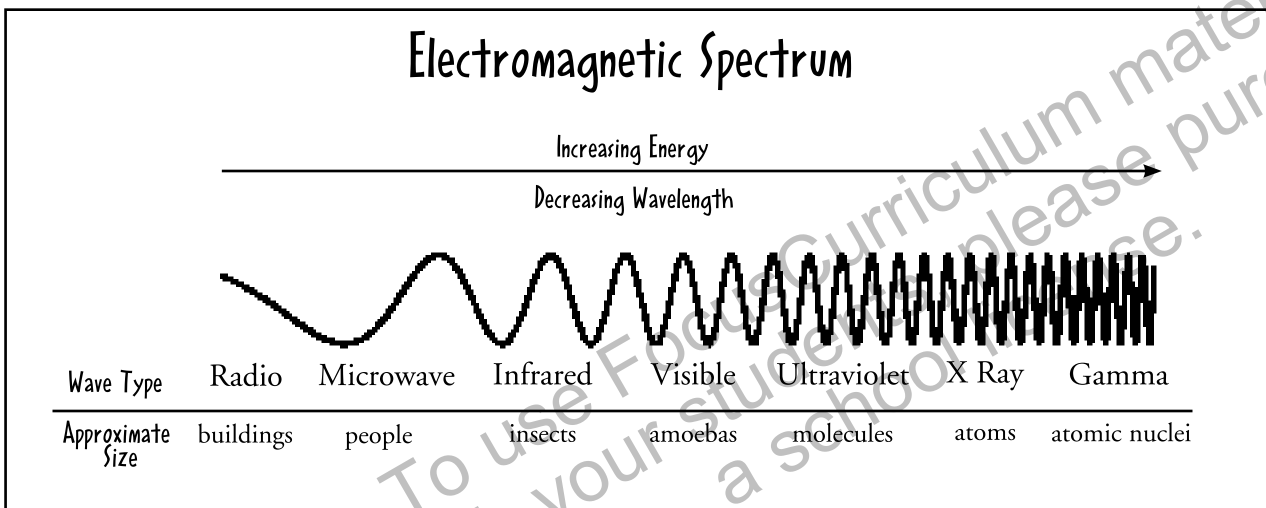
Electromagnetic Waves

Many familiar objects and appliances in your home create electromagnetic waves. The light bulb in your lamp is an example, as is the microwave oven in your kitchen. Seven types of electromagnetic waves make up the **electromagnetic spectrum**: gamma, x-ray, ultraviolet, visible light, infrared, microwave, and radio. All of these waves are related, but each has a different wavelength. Electromagnetic waves are different from mechanical waves, such as sound, because they don't require a medium through which to travel. They can travel through the vacuum of space. When they travel through space, all waves in the spectrum travel at the speed of light (186,000 miles per second).



Of all the electromagnetic waves, gamma waves produce the most energy and are the most deadly. Gamma rays are produced when a nuclear bomb explodes. X-rays can pass through skin, but not bone. Ultraviolet waves are given off by the sun and can cause sunburns and damage the eyes if they are left unprotected.

Visible light waves are the only part of the spectrum that can be seen by humans. Infrared waves can't be seen, but can be felt as heat. Microwaves, also called radar waves, are used for locating airplanes and submarines. The waves that cook your frozen dinner are another type of microwave.

At the other end of the spectrum are radio waves. Without radio waves, your radio would be silent and your television screen blank. Your cell phone would be useless.

ACTIVE READER

1 Investigate *Which of your appliances at home use waves from the electromagnetic spectrum? List two or three and tell the kind of electromagnetic waves they create.*

____

____

____

____

____

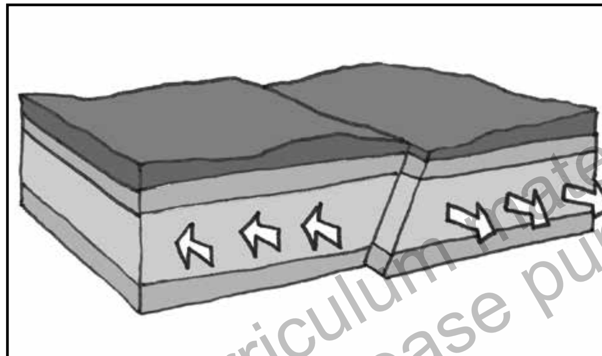
Good to Know

Electromagnetic waves vary by wavelength. Radio waves are very long; some are as long as a building is tall. Visible light has a wavelength that is about the size of an amoeba. On the other end of the spectrum, gamma rays have a wavelength that is smaller than the nucleus of an atom.

Seismic Waves

Seismic waves cannot be seen, but they sure can be felt. Seismic waves are the release of energy that cause earthquakes. These kinds of energy waves form when tectonic plates on either side of a **fault** push against each other. Eventually, the plates will slip or move past each other, and the pressure released causes violent waves that pass through Earth's crust. From the **focus**, or center, of the earthquake, the waves spread out in all directions.

There are three kinds of seismic waves—P waves, S waves and ground waves. P waves can travel through Earth's molten core. S waves can only go through solid parts of Earth's crust and mantle. Ground waves travel along the surface of the Earth and cause the most damage.



Earthquakes happen when two plates move against each other. This movement creates a release of energy that forms seismic waves.

Web Quest

Most earthquakes in the United States occur on the West Coast along the San Andreas Fault. This is where the Pacific Plate and the North American Plate move against each other. However, there have been earthquakes in New York, too. Search the Internet using the term New York Earthquake. List the date and place where two earthquakes have occurred. Find out what caused them.

Good to Know

It is important to know what to do when an earthquake occurs. If you are inside, you should drop to the floor and take cover under a sturdy desk or table. If you are outside, try to get to an open space, away from buildings, streetlights, or power lines.

FOCUS QUESTIONS

1. What do waves carry along from one place to another?

____

____

2. Complete the diagram below.

gamma → ____________ → ultraviolet → visible light → ____________ → microwave → radio

Stop and Think

This page will help you summarize what you have read so far.

Tip:
An effect is the result of a cause. Reread to recall the effect of rocks pushing against each other.

1. Complete this chart to show the effect of plates on either side of a fault pushing against each other. Then describe the kind of energy that is involved.

Cause	Effect
Plates on either side of a fault press against each other.	

____

2. Which type of seismic wave causes the most damage at the Earth's surface?

(1) P waves (3) S waves

(2) Gamma rays (4) Ground waves

3. What are two examples of media that sound waves can travel through?

____

____

Dear Ms. Understanding,

Does the ground really open up when there is an earthquake? Is that what causes all the damage?

Confused in Canarsie

Dear Confused,

No, the ground does not actually open up when there is an earthquake. In fact, if it did, there would not be any earthquakes because there would not be any friction to cause the build up of energy that causes earthquakes. Sometimes a highway or other paved surface may crack, causing crevasses, but the ground will not open up and swallow people and buildings.

Ms. Understanding

Chapter 2 Measuring Energy Waves

FOCUS The underlined sentence states important information about how sound waves are measured. Read on to learn about loudness and pitch.

Measuring Sound Waves

A sound can be measured in two ways: its intensity or loudness and its frequency, or **pitch**. The intensity of a sound is measured in **decibels** (dB). The more intense the sound, the higher it is on the decibel scale. Anything above 85 dB is damaging to our ears.

Sound waves that produce a short wave pattern make soft sounds. Sound waves that produce a tall wave pattern make loud sounds. Sound wave patterns are measured using a machine called an **oscilloscope**.

In addition to being soft or loud, a sound can be low-pitched or high-pitched. A low-pitched sound is produced by sound waves that vibrate slowly. A high-pitched sound is produced by sound waves that vibrate more quickly. A tractor-trailer makes a low-pitched sound as it rumbles down the highway. A bird makes a high-pitched sound when it calls to another bird. Humans cannot detect some sounds that are very high-pitched or very low-pitched.

ACTIVE READER

1 Report *How loud is a dog's bark? Where do you think the sound of a dog barking falls on the decibel scale? Is a dog's bark high-pitched or low-pitched?*

____

____

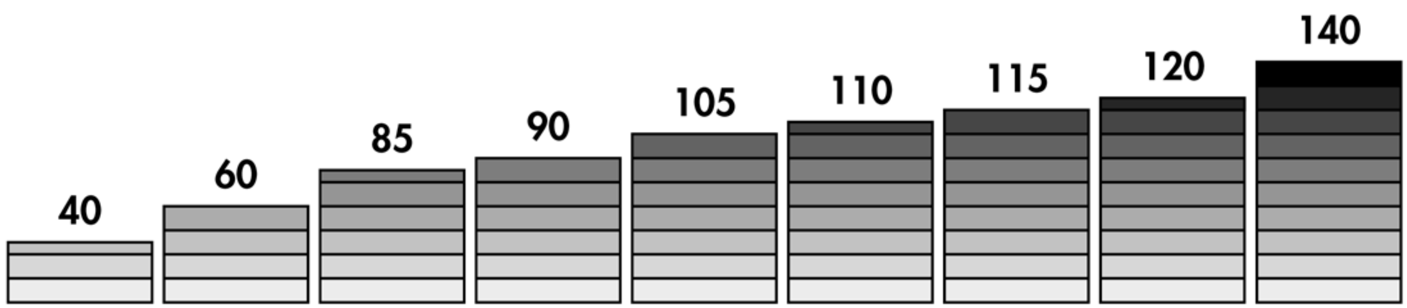
____

____

____

Decibel Scale

1 dB: rustling leaves | *40 dB: television* | *65 dB: office noise* | *85 dB: factory noise* | *100 dB: jackhammer* | *140 dB: fireworks*



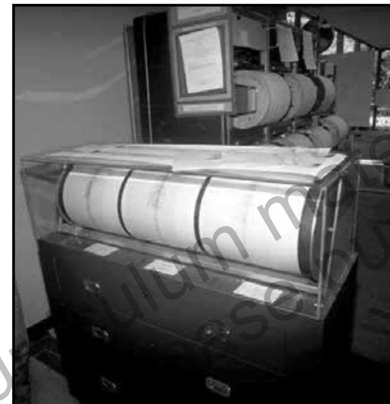
Scientists use the decibel scale to measure the loudness of sounds.

Measuring Earthquake Waves

The **magnitude**, or size, of an earthquake is measured using a tool called a **seismograph**. This machine produces a squiggly line when the tremors occur. The bigger the squiggle, the bigger the tremor. A seismograph can record tremors that occur thousands of miles away. There are seismograph stations all over the globe.

Scientists use the **Richter Scale** to measure the amount of energy released by an earthquake. Each number on the scale represents an earthquake 10 times more powerful than the number below it. For example, an earthquake that registers a 6 on the Richter Scale is ten times more powerful than an earthquake that registers a 5. Earthquakes that register at 2 or below are not always felt. The highest magnitude ever recorded using the Richter Scale was 9.5 when a massive earthquake struck Chile on May 22, 1960.

More than a million earthquakes occur each year, but most of them are minor, registering below 2 on the Richter Scale. Scientists closely monitor seismographs in an attempt to predict when a significant earthquake might happen.



Scientists measure the strength of an earthquake using a seismograph.

FOCUS QUESTIONS

1. **What is the decibel scale?**

____

____

2. **Describe how a seismograph works.**

____

____

ACTIVE READER

1 Infer *How many times more powerful was the 8.8 earthquake that struck Chile in February 2010 than the 7.0 quake that struck Haiti earlier that same year?*

___ *between 1 and 10 times*

___ *between 10 and 20 times*

___ *between 10 and 100 times*

Good to Know

Charles F. Richter was born in 1900 on Sunnyside Farm in Overpeck, Ohio. Overpeck is near Cincinnati, Ohio in Butler County. He developed a way to measure the magnitude of earthquakes, which became known as the Richter Scale.

Stop and Think

This page will help you summarize what you have read so far.

Tip:
Look back through the chapter to find the words in the answer. Reread the sentences that contain those words.

1. What is one way in which the sounds created by a fire alarm and a drum are alike?

____

____

____

2. What is one way in which the sounds created by a fire alarm and a drum are different?

____

____

____

3. Which of these is used to display sound wave patterns?

(1) decibel scale
(2) Richter scale
(3) seismograph
(4) oscilloscope

Dear Ms. Understanding,

The other day on the news, a reporter briefly mentioned a magnitude 5.9 earthquake that occurred in an unpopulated area. Yet, I have heard a great deal about smaller magnitude earthquakes that occurred near large cities. Why is the smaller earthquake a bigger news story?

Mystified in Monroe County

Dear Mystified,

A major factor in determining how devastating an earthquake is where it occurs. A large magnitude earthquake that occurs in an unpopulated or sparsely populated area is most likely going to cause less damage than a smaller earthquake that happens in a large city, where there are more buildings and roads.

Ms. Understanding

Chapter 3 Visible Light

FOCUS This section explain important ideas about light. As you read, discover how light waves behave.

What Is Light?

You open your eyes in the morning and look around. There is a fly sleeping upside down on the ceiling. Outside the window are colorful cars on the street. You look at your clothing for the day. 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.

The type of light 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 light with all the visible light, we see white light or light without color.

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

Particles in matter can gain and lose energy. When they gain energy they become "excited." One way to excite particles is to heat them. For example, when particles in metal are heated, the excited particles give off energy. That makes the metal turn red. In a red-hot object, the particles are getting enough energy to begin producing light that we can see.

When the metal gets even hotter, it turns white. Its particles are very excited and are giving off lots of energy. All of the colors of light are being generated. The colors mix together and look white.

glowing hot molten metal
Image: Kittikun Atsawintarangkul / FreeDigitalPhotos.net

ACTIVE READER

1 Recall *Where does visible light fall on the electromagnetic spectrum?*

____

____

____

____

2 Infer *As metal heats up, it begins to glow red. As it get hotter, it turns white. This suggests that which of the following statements is true?*

(1) As metal heats up, energy waves are released in shorter and shorter wavelengths.

(2) As metal heats up, energy waves are released in longer and longer wavelengths

How Light Behaves

Light travels in a straight line until it hits an object. It may pass through it. It may also bounce off the object. Light that bounces is called reflected light. Smooth surfaces reflect light waves in one direction. Rough surfaces reflect light but scatter it in many directions. This is why we can see ourselves in a mirror but not in a wool sweater.

Refracted light is not absorbed by an object but rather passes through it. The light refracts, or bends. The amount of bending depends on the material. For example, when light passes through water, the particles in water slow the light down and bend it. This causes a pencil to appear to be bent when placed in a glassful of water. Try it. Some materials slow down and refract light more than others.

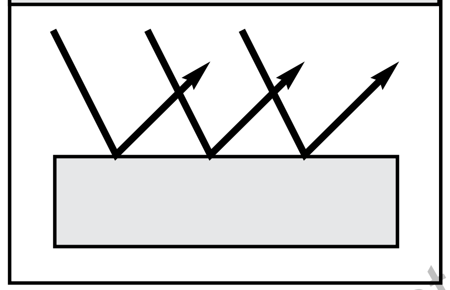
Absorbed light enters an object without bouncing off or passing through it. The particles that make up some materials absorb certain colors of the visible spectrum. The remaining color or colors reflect from the material. Our eyes can then sense the color or colors reflected.

The Visible Light Spectrum

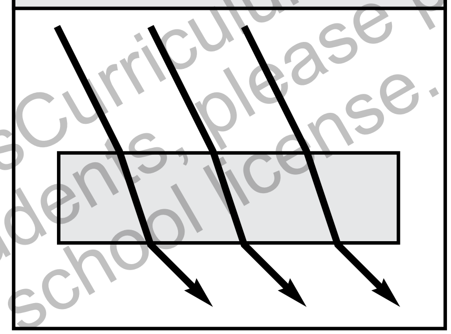
Isaac Newton was a leader in the study and uses of light in the 1600s and 1700s. He experimented with the white light to discover how it was related to color.

In his experiment, Newton shaded a window. The shade had a hole in it. One beam of sunlight entered the room through the hole. Newton placed a prism, a wedge-shaped piece of polished glass, in the sunlight.

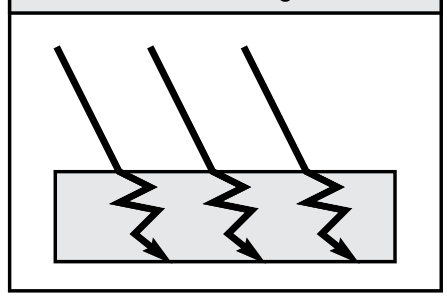
Reflected Light



Refracted Light



Absorbed Light



ACTIVE READER

1 Analyze *The diagram of refracted light on this page shows that the light is bent twice. Use the diagram to explain in your own words what causes light to be refracted.*

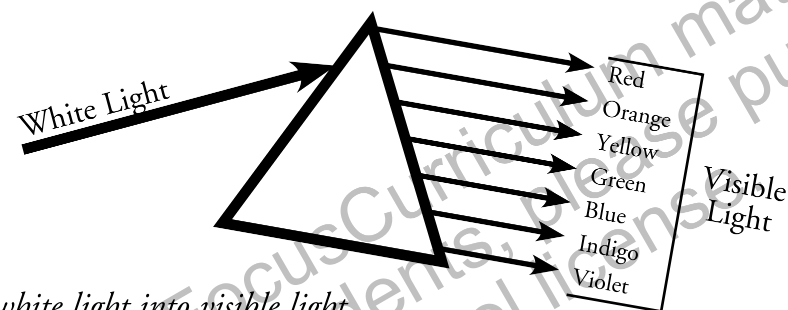
Good to Know

A rainbow is produced when the Sun shines through tiny rain droplets that fill the air. The droplets act like a prism and refract white light into the visible color spectrum. You can only see a rainbow if the sun is behind you. The rainbow then appears in front of you.

The prism split the invisible white light into its components: visible colored light. When white light passes through a prism, the various colors bend, or refract, different amounts according to their wavelengths. In this way, they spread out and are made visible. 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.

The colors of light that make up the visible spectrum are the colors in a rainbow. You can easily remember them by using the acronym, ROY G. BIV, which stands for Red, Orange, Yellow, Green, Blue, Indigo, and Violet. These are the colors of the visible spectrum in the correct order of their wavelength.

Web Quest Sir Isaac Newton was one of the most important scientists who ever lived. Find out more about his life and discoveries and share information about him with others in the form of an oral report, video, or slide presentation.



A prism splits white light into visible light.

FOCUS QUESTIONS

1. **Sometimes when light hits an object, some of the light is absorbed and some is reflected. How do we sense the reflected light?**

___

___

___

Stop and Think

This page will help you summarize what you have read so far.

1. Which explains why a yellow sweater appears yellow?

(1) The sweater reflects all colors including yellow.

(2) The sweater absorbs all colors except yellow, which it reflects.

(3) The sweater refracts all colors except yellow, which it absorbs.

(4) The sweater absorbs only the color yellow, and reflects all others.

2. Light is refracted when it passes through an object that

(1) causes it to bounce off

(2) traps it and won't let it escape

(3) bends it as it passes in and out

(4) allow it to pass through without changing speed

3. Which color of visible light has the longest wavelength? Which has the shortest?

____

____

Dear Ms. Understanding,

I thought that light was reflected only from shiny surfaces such as mirrors or polished metal. How can something soft and dull reflect light?

Lit Up in Levittown

Dear Lit,

There are two ways that you can see things. The Sun and stars, for example, produce light and send it to your eye where you receive it. You can only see other objects because light reflects off them and travels directly to you eye. So, the ability to reflect light is not a property of shiny things alone. Everything you see reflects light.

Ms. Understanding

Glossary

amplitude – half distance between the crest and trough of a wave

crest – the highest point of a wave

decibel – measurement used to assess the loudness of a sound

electromagnetic waves – waves that carry energy as electricity and magnetism at the speed of light

electromagnetic spectrum – seven types of waves (gamma rays, X-rays, ultraviolet waves, visible light waves, infrared waves, microwaves, and radio waves) that carry energy as electricity and magnetism

fault – cracks in the earth along which bodies of rock move

focus – exact point where the earth moves causing an earthquake

frequency – the number of times a wave passes a certain point

kinetic energy – energy of objects in motion

longitudinal waves – waves that move back and forth

magnitude – the size of an earthquake

medium – substance, such as air or water, that energy uses to move back and forth

oscilloscope – a machine that translates sound into a pattern; it measures sound waves

pitch – property of sound which makes it high or low

potential energy – stored energy

Richter scale – a scale used to measure the amount of energy released by an earthquake

seismograph – an instrument that measures the vibrations of a seismic wave

transverse waves – waves that move up and down

trough – the lowest point of a wave

wavelength – the distance between two waves

FOCUS ON SCIENCE

Energy Waves

Assessments

Check Understanding

In the Answer Document on this page, mark your answer in the row of circles for each question by filling in the circle that has the same number as the answer you have chosen.

1. Which term refers to the highest point of a wave?

   (1) crest

   (2) trough

   (3) amplitude

   (4) wavelength

2. Sound will not travel in space. What is space lacking that stops sound from traveling?

   (1) air

   (2) gravity

   (3) vibrations

   (4) gamma rays

3. Light that enters an object but does not leave is

   (1) reflected then absorbed

   (2) refracted then absorbed

   (3) absorbed then reflected

   (4) refracted then reflected

4. Why are earthquakes less common in New York than they are in California?

   (1) New York is above sea level.

   (2) New York does not have a coastline.

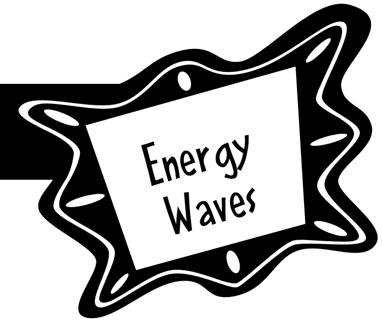
   (3) New York does not have active volcanoes.

   (4) New York does not sit along a major fault line.

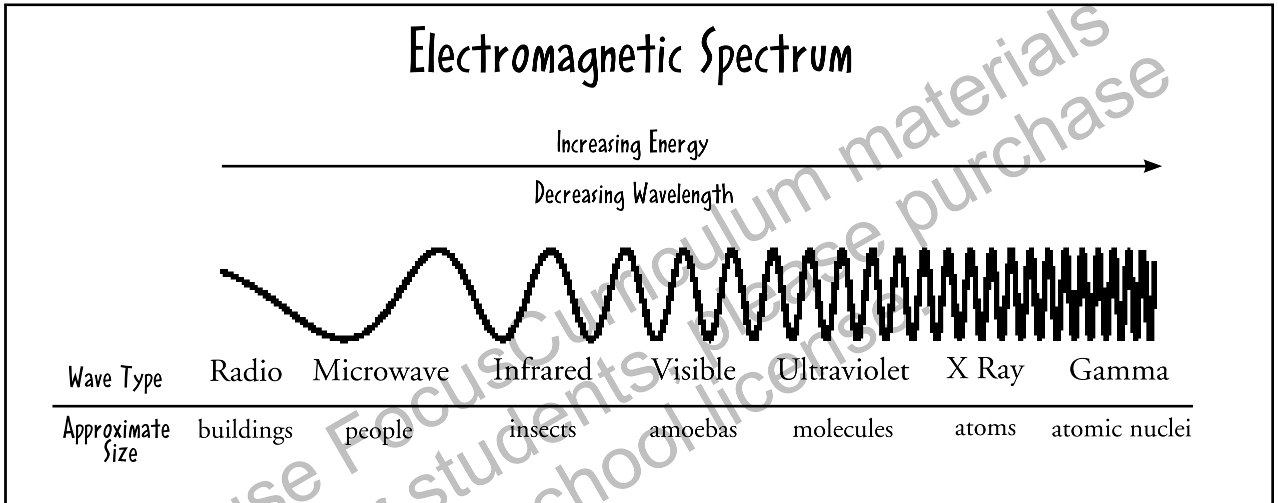
Answer Document

1.	①	②	③	④	3.	①	②	③	④
2.	①	②	③	④	4.	①	②	③	④

Check Understanding



Base your answers to questions 5 and 6 on the diagram of the electromagnetic spectrum and on your knowledge of science.



5. . Choose one type of wave from the diagram. Describe this type of wave in your own words.

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6. Explain where such a wave might come from or how it might be created.

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FOCUS ON SCIENCE

Energy Waves

Answer Key

Answer Key

Page 8: Starting Points:
Build Background
Explain: Answers will vary according to the student's prior knowledge.
Brainstorm: Answers will vary.
Define: Potential energy is energy that is stored and kinetic energy is motion energy.

Page 9: Starting Points:
Key Vocabulary
Rate Your Knowledge: Answers will vary.
Use Roots to Unlock Meaning: Students should circle 1. autograph, 2. photograph, 3. telescope, 4. stethoscope, 5. electricity, 6. electrician

Page 10: Starting Points:
Key Concepts
Active Reader: Identify: 2, 1, 3

Page 11: Starting Points:
Key Concepts
Hands on Science: Watch Waves:
1. transverse, high, high; 2. longitudinal, low, low; 3. transverse, low, low

Page 12: Chapter 1
Active Reader: 1. Infer: Air would transmit the sound of banging on a drum faster than water.; 2. Connect: Answers will vary.

Page 13: Chapter 1
Active Reader: 1. Investigate: Answers will vary, but students should list appliances that use waves from the electromagnetic spectrum, such as microwave oven, television, radio, or computer.

Page 14: Chapter 1
Focus Questions: 1. To move energy from one place to another.; 2. gamma rays, X-rays, ultraviolet rays, visible light, infrared rays, microwaves, radio waves

Page 15: Chapter 1
Stop and Think: 1. Cause: Plates on either side of a fault line press against each other. Effect: The plates build up potential energy. When they finally slip, the stored up energy is released and causes an earthquake.; 2. (4); 3. Sound waves travel through air and water.

Page 16: Chapter 2
Active Reader: 1. Report: A dog barking would be in the middle of the decibel scale and it could be either high- or low-pitched.

Page 17: Chapter 2
Active Reader: 1. Infer: The 8.8 Chile earthquake was between 10 and 100 times stronger than the 7.0 Haiti earthquake.
Focus Questions: 1. The decibel scale is used to measure the loudness of a sound.; 2. A seismograph measures tremors in the earth. A pen hangs over a roll of paper. As the tremors occur, the pen makes wiggles on the paper. The more intense the tremor, the bigger the wiggle.

Page 18: Chapter 2
Stop and Think: 1. They are both caused by vibrations; they both can be loud; 2. They are different in that one is high-pitched, one is low-pitched. 3. (4)

Page 19: Chapter 3
Active Reader: 1. It falls in the middle between infrared and ultraviolet light.

Page 20: Chapter 3
Active Reader: 1. Light is refracted when it goes from one type of material to another. So, when it passes through glass, it is bent when it goes from air to glass and is bent again when it goes from glass to air.

Page 21: Chapter 3
Focus Questions: 1. Reflected lights enters our eye and we see the object off of which it has been reflected.

Page 22: Chapter 3
Stop and Think: 1. (2); 2. (3); 4. Of the visible light, red has the longest wavelength and indigo has the shortest.

Page 27: Assessments
Check Understanding: 1.(1); 2. (1); 3. (2); 4. (4)

Page 28: Assessments
Check Understanding: 5. Sample answer: X-rays are rays that can pass through skin, but not bone. 6. You might find machines that create x-rays in a dentist's office or hospital.