

Name \_\_\_\_\_

Date \_\_\_\_\_


**Section**  
**4.3**  
**Summary**

**Light and the Electromagnetic Spectrum**

Textbook pages 152–165

**Before You Read**

Choose a technology that uses invisible waves, such as microwave ovens, radio, X rays, or wireless Internet connections. Explain how the technology affects your life.

 **Mark the Text**

**Identify Details**

Highlight the names of different types of waves as you read them. Say their names aloud. Underline the names of technologies that depend on the waves.

 **Reading Check**

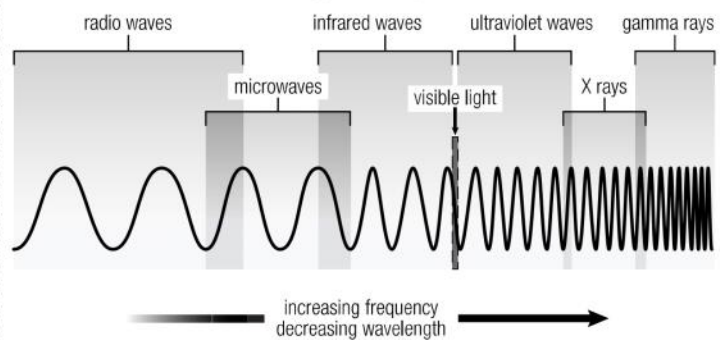
1. What larger spectrum of waves is the visible spectrum part of?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**What is the electromagnetic spectrum?**



Light that you can see is an example of a form of energy called **radiant energy**. This energy spreads out, or radiates, from its source in all directions. The Sun is a source of radiant energy. Radiant energy is not just visible light. The Sun and other sources of energy also give off energy in waves you cannot see. These waves transport energy by the vibration of electrical and magnetic fields. That is why these waves, including visible light waves, are known as **electromagnetic radiation**.

The spectrum of electromagnetic radiation is known as the **electromagnetic spectrum**. The electromagnetic spectrum includes radio waves, which can have wavelengths that are kilometres long. It also includes gamma rays, which can have wavelengths smaller than an atom. The spectrum includes all the electromagnetic waves in between. ✓

**What waves have wavelengths longer than visible light?**

- ◆ **Radio waves** have the longest wavelengths in the electromagnetic spectrum. Radio waves are used for broadcasting radio and television signals. Radio waves are also used in medicine. They allow us to see inside our bodies using magnetic resonance imaging (MRI). **Microwaves** are a type of radio wave. As well as being used in microwave ovens, microwaves are also used to communicate with satellites.
- ◆ **Infrared waves** have wavelengths longer than red light in the visible spectrum. Heat lamps used by restaurants to keep food warm emit invisible infrared waves as well as red light. Infrared waves are also used in remote controls for televisions and for reading CD-ROMs. Infrared waves are also called heat radiation. ✓

**What waves have wavelengths shorter than visible light?**

- ◆ **Ultraviolet waves** have wavelengths shorter than violet light in the visible spectrum. Your body needs to absorb ultraviolet waves to make vitamin D. Too much exposure to ultraviolet waves, though, can result in sunburns and skin cancer. Ultraviolet waves are used to kill bacteria found in food, water, and on medical tools.
- ◆ **X rays** have shorter wavelengths and higher energy and frequencies than ultraviolet waves. X rays are used to photograph bones and teeth, to check the inside of baggage at airports, and to check jet engines and other machines for damage.
- ◆ **Gamma rays** have the shortest wavelengths, the highest energy, and the highest frequency of the electromagnetic spectrum. Gamma rays are used in radiation therapy to kill cancer cells.

**✓ Reading Check**

2. What are three uses for infrared waves?

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Name \_\_\_\_\_

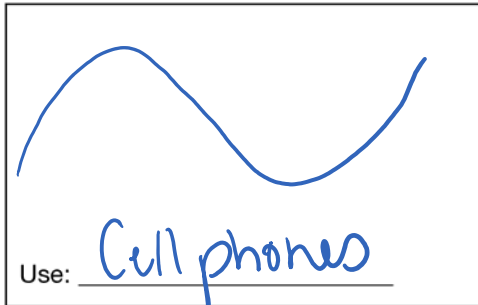
Date \_\_\_\_\_

Use with textbook pages 152-160.

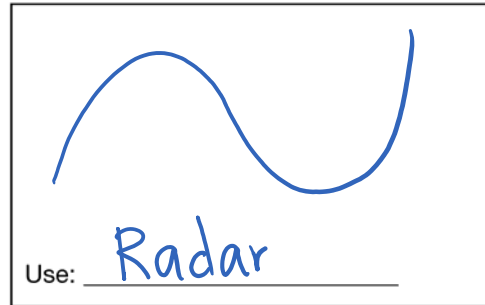
## The electromagnetic spectrum

Write a use for each electromagnetic radiation stated below. In the box provided, draw a picture to illustrate your example.

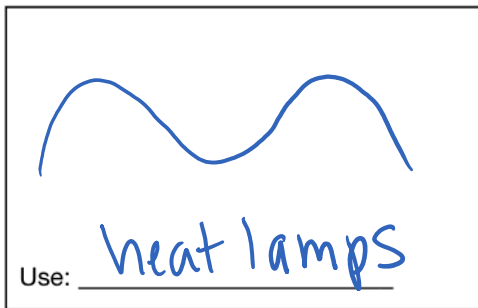
1. Radio waves



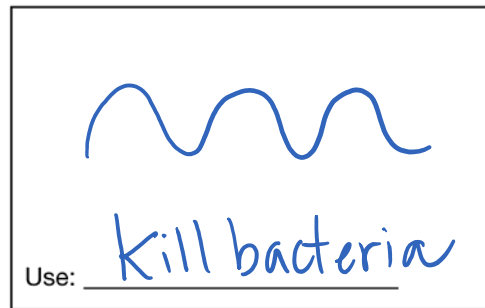
2. Microwaves



3. Infrared waves



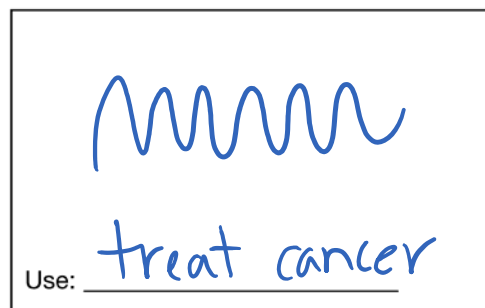
4. Ultraviolet rays



5. X rays



6. Gamma rays



Use with textbook pages 152–160.

## True or false?

Read the statements given below. If the statement is true, write “T” on the line in front of the statement. If it is false, write “F” and rewrite the statement to make it true.

1. T Radiant energy spreads out from its source in all directions.

2. F Electromagnetic radiation includes only visible light waves.

and many other invisible types of energy

3. F Microwaves are a type of infrared wave.

radio wave

4. F X rays have more energy than gamma rays.

less

5. F Radio waves, microwaves, and ~~ultraviolet waves~~ all have longer wavelengths than visible light.

UV waves have shorter wavelengths than visible light

6. T Both X rays and gamma rays have higher frequencies than ultraviolet rays.

7. F Communicating with satellites is an application of ~~gamma rays~~.

radio waves

8. T The Sun radiates both visible energy and invisible energy.

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**Cloze  
Activity**

**Section 4.3**

Use with textbook pages 152-160.

## More than meets the eye

### Vocabulary

electromagnetic radiation  
electromagnetic spectrum  
frequency  
gamma rays  
infrared waves  
microwaves

radiant energy  
radio waves  
ultraviolet rays  
visible light  
wavelength  
X rays

Use the terms in the vocabulary box to fill in the blanks. Use each term only once.

1. The electromagnetic spectrum represents the different forms of electromagnetic radiation.
2. Light is classified as electromagnetic radiation because electrical and magnetic fields vibrate in a light wave.
3. Radiant energy is energy that travels by radiation. An example of this is light.
4. Heat radiation, also known as infrared waves, cannot be seen by your eyes but can be felt by your skin.
5. Microwaves are one type of radio wave.
6. Radio waves can be used to communicate with satellites.
7. Because gamma rays have the highest energy of all electromagnetic radiation, they are the most damaging to human tissue.
8. Compared to all other types of electromagnetic radiation, radio waves have the lowest frequency.
9. An overexposure to UV rays can result in sunburns and skin cancer.

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Use with textbook pages 152–160.

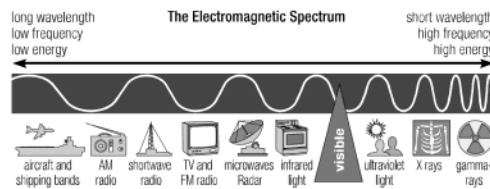
## Visible light and the electromagnetic spectrum

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. <u>E</u> X rays	A. used to heat up left-over pizza
2. <u>A</u> microwaves	B. used to broadcast television
3. <u>D</u> gamma rays	C. used by computers to read CD-ROMS
4. <u>B</u> radio waves	D. used in radiation therapy to kill cancer cells
	E. used by dentists to take a picture of your teeth

Circle the letter of the best answer.

Use the following diagram of the electromagnetic spectrum to answer questions 5 to 10.



5. Which of the following types of radiation has the highest frequency?

- A. visible light
- D B. infrared light
- C. AM radio waves
- D D. gamma radiation

6. Which of the following is generally associated with radio waves?

- D A. visible radiation
- B. high-energy waves
- C. high-frequency waves
- D D. long-wavelength waves

7. Which of the following types of radiation gives off the lowest amount of energy?

- C A. X rays
- B. visible light
- C C. microwaves
- D. gamma rays

8. Which of the following correctly places these electromagnetic waves in order from shortest wavelength to longest wavelength?

- A. visible light, radio waves, ultraviolet light, infrared radiation
- C B. radio waves, visible light, infrared radiation, ultraviolet light
- C C. ultraviolet light, visible light, infrared radiation, radio waves
- D. ultraviolet light, infrared radiation, radio waves, visible light

9. Which of the following has a higher frequency than visible light?

- A. infrared waves
- B B. X rays
- B C. microwaves
- D. radio waves

10. How does the frequency of electromagnetic radiation change as wavelength of the radiation decreases?

- A A. it increases
- B. it decreases
- C. it stays the same
- D. it increases and then decreases