

Waves of the Electromagnetic Spectrum (pages 74–81)

What Is the Electromagnetic Spectrum?

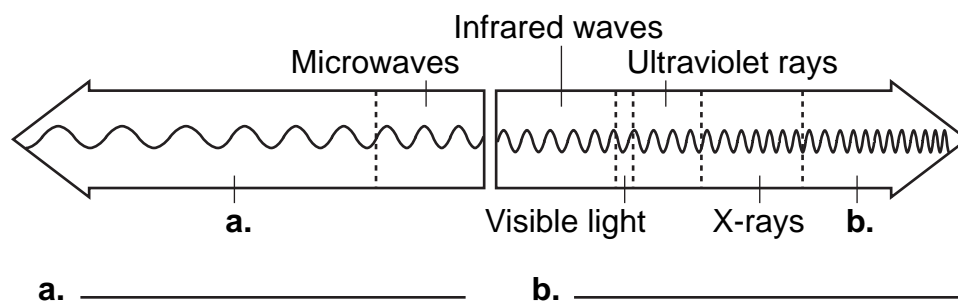
(page 75)

Key Concept: All electromagnetic waves travel at the same speed in a vacuum, but they have different wavelengths and different frequencies. The electromagnetic spectrum is made up of radio waves, infrared rays, visible light, ultraviolet rays, X-rays, and gamma rays.

- The **electromagnetic spectrum** is the complete range of electromagnetic waves. The waves are placed in order of increasing frequency. As the frequencies of the waves get higher, their wavelengths get shorter.
- At one end of the electromagnetic spectrum are radio waves. Radio waves have low frequencies and long wavelengths. At the other end of the spectrum are gamma rays. Gamma rays have high frequencies and short wavelengths.
- The higher the frequency of electromagnetic waves, the more energy they have. Gamma waves have the highest frequency, so they have the most energy.

Answer the following question. Use your textbook and the ideas above.

1. The diagram shows the electromagnetic spectrum. Fill in the missing waves.



The Electromagnetic Spectrum ▪ *Adapted Reading and Study***Radio Waves** (page 76)

Key Concept: Radio waves are at one end of the electromagnetic spectrum.

- **Radio waves** are electromagnetic waves with the lowest frequencies and longest wavelengths.
- Radio waves with the very lowest frequencies are used to carry signals for radio and television programs.
- Radio waves with the highest frequencies are called **microwaves**. Microwaves are used to cook food. Microwaves are also used in radar. **Radar** uses reflected microwaves to detect objects, such as moving cars.

Answer the following question. Use your textbook and the ideas above.

2. Circle the letter of each sentence that is true about radio waves.
 - a. Radio waves have very high frequencies.
 - b. Radio waves have very long wavelengths.
 - c. Radio waves include microwaves.

Infrared Rays (page 77)

Key Concept: Infrared rays follow radio waves in the electromagnetic spectrum.

- **Infrared rays** are electromagnetic waves with higher frequencies and shorter wavelengths than radio waves.
- Infrared rays have more energy than radio waves because they have higher frequencies. You can feel the energy of infrared rays as heat. Heat lamps give off infrared rays.
- Most objects give off some infrared rays. You can use an infrared camera to see objects in the dark.

The Electromagnetic Spectrum ▪ *Adapted Reading and Study*

Answer the following questions. Use your textbook and the ideas on page 39.

3. Is the following sentence true or false? Infrared rays have lower frequencies than radio waves? _____
4. Circle the letter of a use of infrared rays.
 - a. heat lamps
 - b. television signals
 - c. radar

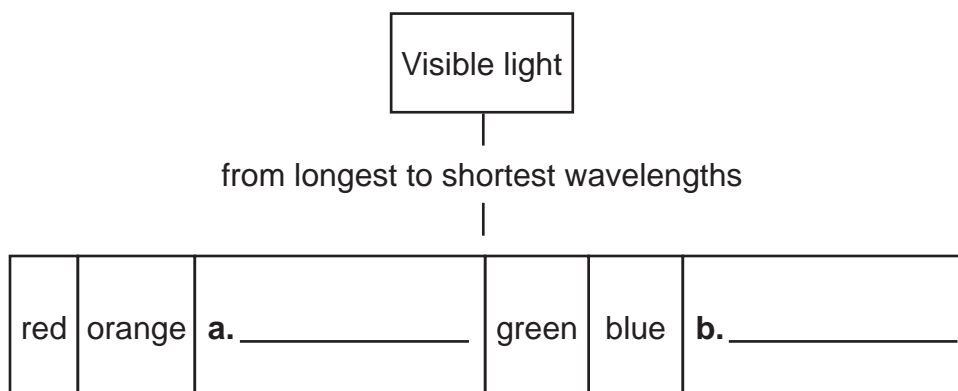
Visible Light (page 78)

Key Concept: Visible light follows infrared rays in the electromagnetic spectrum.

- Electromagnetic waves that you can see are called **visible light**. Visible light has higher frequencies and shorter wavelengths than infrared rays.
- We see different wavelengths of visible light as different colors. From longest to shortest wavelengths, the colors of visible light are red, orange, yellow, green, blue, and violet. Visible light that looks white is really a mixture of all the different colors of light.

Answer the following question. Use your textbook and the ideas above.

5. Fill in the blanks in the concept map about visible light.



The Electromagnetic Spectrum ▪ *Adapted Reading and Study***Ultraviolet Rays** (page 78)

Key Concept: Ultraviolet rays follow visible light in the electromagnetic spectrum.

- **Ultraviolet rays** are electromagnetic waves with higher frequencies and shorter wavelengths than visible light.
- Ultraviolet rays have more energy than visible light because they have higher frequencies.
- Ultraviolet rays help our bodies make vitamin D. However, too many ultraviolet rays can cause sunburn and skin cancer.

Answer the following question. Use your textbook and the ideas above.

6. Circle the letter of each sentence that is true about ultraviolet rays.
- a. Ultraviolet rays have higher frequencies than visible light.
 - b. Ultraviolet rays have longer wavelengths than visible light.
 - c. Ultraviolet rays have less energy than visible light.

X-Rays (page 79)

Key Concept: X-rays follow ultraviolet rays in the electromagnetic spectrum.

- **X-rays** are electromagnetic waves with higher frequencies and shorter wavelengths than ultraviolet rays.
- X-rays have more energy than ultraviolet rays because they have higher frequencies. X-rays have enough energy to pass through many materials, including skin.
- X-rays are used to take pictures of bones and teeth. Too many X-rays can cause cancer.

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Answer the following questions. Use your textbook and the ideas on page 41.

7. Is the following sentence true or false? X-rays have higher frequencies and shorter wavelengths than ultraviolet rays. _____
8. Circle the letter of a use of X-rays.
- a. making vitamin D
 - b. taking pictures of bones and teeth
 - c. heating food

Gamma Rays (pages 80–81)

Key Concept: Gamma rays follow X-rays in the electromagnetic spectrum.

- **Gamma rays** are electromagnetic waves with the highest frequencies and shortest wavelengths.
- Gamma rays have more energy than any other type of electromagnetic wave. Gamma rays have enough energy to pass through most materials.
- Gamma rays can be used to kill cancer cells inside the body.
- Some objects in space give off gamma rays. Special telescopes can detect these gamma rays.

Answer the following questions. Use your textbook and the ideas above.

9. The electromagnetic waves with the highest frequencies and shortest wavelengths are _____.
10. Is the following sentence true or false? Gamma rays have more energy than X-rays. _____