The Waves of the Spectrum

What waves are included in the electromagnetic spectrum?

The electromagnetic spectrum includes radio waves, infrared rays, visible light, ultraviolet rays, X-rays, and gamma rays.

The Waves of the Spectrum

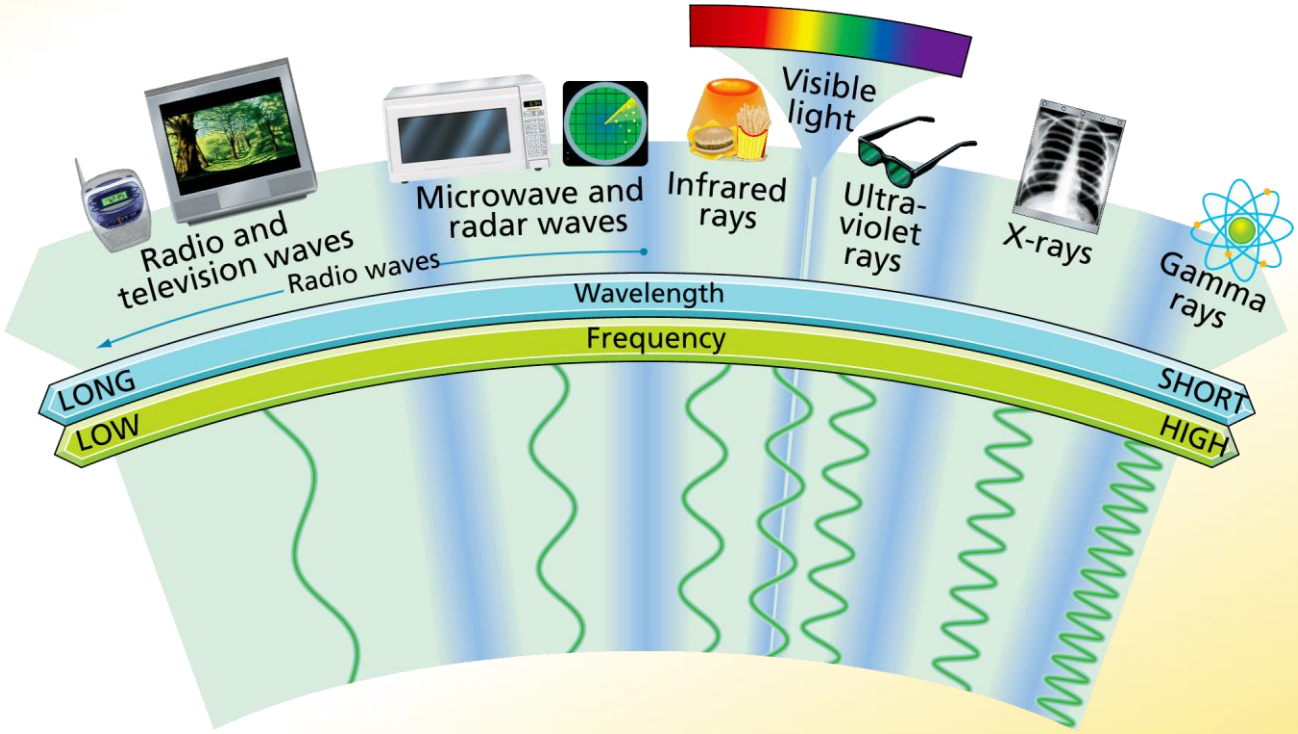
The full range of frequencies of electromagnetic radiation is called the **electromagnetic spectrum.**

- Visible light is the only part of the electromagnetic spectrum that you can see, but it is just a small part.
- Each kind of wave is characterized by a range of wavelengths and frequencies. All of these waves have many useful applications.
- **DOK Question**

Compare each with your prior knowledge.

The Waves of the Spectrum

The electromagnetic spectrum consists of radio waves, infrared rays, visible light, ultraviolet rays, X-rays, and gamma rays.



Radio Waves

- How are radio waves used?
- Radio waves are used in radio and television technologies, as well as in microwave ovens and radar.

Radio Waves

There are two ways that signals are encoded for radio.

- In **amplitude modulation,** the amplitude of the wave is varied. The frequency remains the same. AM radio stations broadcast by amplitude modulation.
- In **frequency modulation,** the frequency of the wave is varied. The amplitude remains the same. FM stations broadcast by frequency modulation.

DOK Question

Compare the two for importance.

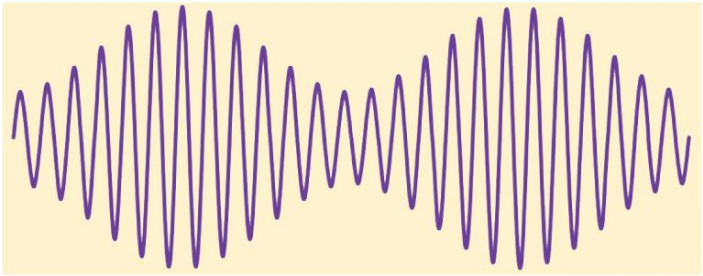
Radio Waves

The announcer's voice and the music on CD leave the radio studio as electronic signals. Those signals are used to produce a wave with either a varying amplitude or a varying frequency.

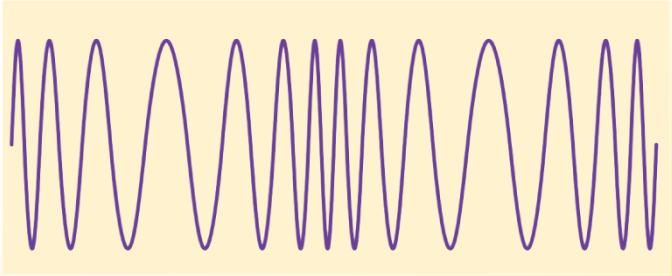
A. AM waves have a varying amplitude.

B. FM waves have a varying frequency.

A Amplitude modulation



B Frequency modulation



Radio Waves

Television

Radio waves also carry signals for television programming. The radio waves carry information for pictures as well as for sound.

Location and weather can affect the reception of television signals by an antenna.

Radio Waves

Microwaves

The shortest-wavelength radio waves are called microwaves. Microwave wavelengths are from about 1 m to about 1 mm.

- Frequencies vary from about 300 MHz to about 300,000 MHz.
- Microwaves cook and reheat food. Microwaves also carry cell phone conversations. The process works much like a radio broadcast.

Radio Waves

Radar

The word *radar* is an acronym for *ra*dio *d*etection *a*nd *r*anging. Radar technology uses a radio transmitter to send out short bursts of radio waves.

- The waves reflect off the objects they encounter and bounce back toward where they came from.
- The returning waves are then picked up by a radio receiver.

Infrared Rays

- How are infrared rays used?
- Infrared rays are used as a source of heat and to discover areas of heat differences.

Infrared Rays

Warmer objects give off more infrared radiation than cooler objects.

A device called a thermograph uses infrared sensors to create **thermograms,** color-coded pictures that show variations in temperature.

Search-and-rescue teams use infrared cameras to locate people who are trapped during disasters.

Visible Light

- **How is visible light used?**
- **People use visible light to see, to help keep them safe, and to communicate with one another.**

Visible Light

The visible part of the electromagnetic spectrum is light that the human eye can see.

Each wavelength in the visible spectrum corresponds to a specific frequency and has a particular color.

DOK Question

Hypothesize everyday use.

Ultraviolet Rays

- How are ultraviolet rays used?
- Ultraviolet rays have applications in health and medicine, and in agriculture.

X-Rays

- How are X-rays used?
- X-rays are used in medicine, industry, and transportation to make pictures of the inside of solid objects.

Gamma Rays

How are gamma rays used?

Gamma rays are used in the medical field to kill cancer cells and make pictures of the brain, and in industrial situations as an inspection tool.

Assessment Questions

1. Which waves have the longest wavelength?
   a. radio waves
   b. infrared rays
   c. visible light
   d. ultraviolet rays

   ANS: A

Assessment Questions

2. What type of electromagnetic radiation is used to keep prepared foods warm in a serving area?
   a. ultraviolet rays
   b. infrared rays
   c. X-rays
   d. gamma rays

   ANS: B