

Signals Across Space

Compare transverse-wave properties and connect electromagnetic waves to useful technologies.

8.8 "Force, motion, and energy. The student knows how energy is transferred through waves. The student is expected to: compare the characteristics of amplitude, frequency, and wavelength in transverse waves..."

NAME _____ DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Underline each sentence that compares frequency and wavelength. Circle each electromagnetic-wave application, then write the wave type beside it in the margin.

Waves at Work

- ① Imagine shaking one end of a rope while a partner holds the other end. The rope moves up and down, so it makes a transverse wave. Amplitude is the greatest distance the rope moves from its resting position. A larger amplitude carries more energy. Wavelength is the distance from one crest to the next matching crest. Frequency is the number of complete waves that pass a point each second. If you shake the rope faster, frequency increases and the wavelength becomes shorter when wave speed stays the same.
- ② Electromagnetic waves are transverse waves made of changing electric and magnetic fields. They can travel through empty space, unlike sound waves. The electromagnetic spectrum includes radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays. All electromagnetic waves travel at the same speed in a vacuum. Therefore, waves with higher frequency have shorter wavelengths, while waves with lower frequency have longer wavelengths. Gamma rays have the highest frequencies and shortest wavelengths. Radio waves have the lowest frequencies and longest wavelengths. Amplitude is related to a wave's energy, not its place in the spectrum.
- ③ People choose electromagnetic waves for specific jobs. Radio waves and microwaves carry wireless signals. Microwaves also heat food because water molecules absorb their energy. Fiber-optic cables send information as pulses of visible or infrared light that reflect inside the cable. Ultraviolet light can sterilize surfaces by damaging the genetic material of microorganisms. X-rays pass through soft tissue more easily than bone, helping doctors see broken bones. Radiation therapy uses carefully aimed high-energy radiation to damage cancer cells. Astronomers observe many kinds of electromagnetic waves to learn about objects in space.

2 ANSWER WITH EVIDENCE _____ Use the passage

1 When the frequency of an electromagnetic wave increases, what happens to its wavelength? Why?

2 Compare radio waves and gamma rays by frequency and wavelength.

3 What does amplitude tell about a wave, and what does it not determine on the electromagnetic spectrum?

4 Why can X-rays help a doctor check for a broken bone?

3 YOUR TURN _____ Your own words

Create a three-row plan for a science and health center. In each row, choose a different electromagnetic wave from the passage, name a specific use from the passage, and explain why that wave is useful. Include at least one health-related use.

ELECTROMAGNETIC WAVE	SPECIFIC USE	WHY IT IS USEFUL

PART 1 • READ AND MARK

Underline each sentence that compares frequency and wavelength. Circle each electromagnetic-wave application, then write the wave type beside it in the margin. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	When the frequency of an electromagnetic wave increases, what happens to its wavelength? Why?	Its wavelength becomes shorter because all electromagnetic waves travel at the same speed in a vacuum.
2	Compare radio waves and gamma rays by frequency and wavelength.	Radio waves have the lowest frequencies and longest wavelengths. Gamma rays have the highest frequencies and shortest wavelengths.
3	What does amplitude tell about a wave, and what does it not determine on the electromagnetic spectrum?	Amplitude is related to the energy a wave carries. It does not determine the wave's place in the electromagnetic spectrum.
4	Why can X-rays help a doctor check for a broken bone?	X-rays pass through soft tissue more easily than bone, so they can help doctors see broken bones.

PART 3 • YOUR TURN (SAMPLE ANSWER)

ELECTROMAGNETIC WAVE	SPECIFIC USE	WHY IT IS USEFUL
Ultraviolet light	Sterilizing tools	It damages the genetic material of microorganisms.
X-rays	Checking for broken bones	They pass through soft tissue more easily than bone.
Radio waves	Carrying a wireless signal	They can carry wireless signals.

Accept equivalent wording that correctly matches a wave type to a use stated in the passage and gives an accurate reason. For the open task, all three wave types must be different, and at least one row must describe a health-related use.