Invisible Hospital Signals

Compare electromagnetic bands through their properties and uses.

PHY.4.9 "Research the different bands of electromagnetic radiation, including characteristics, properties, and similarities/differences."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each band name and one property or use linked to it. Circle two facts that all seven bands share.

A Hospital Across the Spectrum

1 At a hospital, invisible signals help doctors see, communicate, and treat patients. These signals are bands of electromagnetic radiation, arranged from longest wavelength and lowest frequency to shortest wavelength and highest frequency: radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays. In this order, frequency and photon energy rise while wavelength falls. All seven bands are waves made of changing electric and magnetic fields. Unlike sound, they can cross empty space. In a vacuum, every band travels at the same speed, about 300,000 kilometers per second, although their speeds can differ in materials.

2 During a scan, an MRI machine uses radio-frequency pulses and a strong magnetic field to gather signals from the body. Hospital Wi-Fi uses microwaves to send data between devices; microwaves have shorter wavelengths than radio waves but longer wavelengths than infrared. An infrared camera detects radiation from warm skin and displays a temperature pattern. A doctor uses visible light to inspect a patient's eye directly. These four bands differ in wavelength, but each can carry information. Visible light is the only band people can see without equipment; an infrared camera turns invisible signals into a visible display.

3 Other bands demand more care. Ultraviolet light has shorter wavelengths than visible light and can damage skin cells; some ultraviolet lamps disinfect unoccupied rooms. X-rays have still shorter wavelengths and can pass through soft tissue more easily than through bone, making bones stand out in an X-ray image. Gamma rays generally have shorter wavelengths and higher photon energies than X-rays, although their ranges overlap; carefully aimed gamma radiation can destroy cancer cells. X-rays and gamma rays are ionizing: their photons can remove electrons from atoms and damage tissue. Ultraviolet photons at the high-energy end can also cause ionization.

2 ANSWER WITH EVIDENCE

Use the passage

1. How do microwave and infrared wavelengths compare, and what different jobs do these bands do at the hospital?

2. Compare the hospital uses of radio waves and X-rays. Which band has more photon energy?

3. Why do bones stand out in an X-ray image, and how does this use differ from the use of gamma rays?

4. Name two properties all seven bands share in a vacuum. Then compare ultraviolet with visible light in wavelength and one effect.

3 YOUR TURN

Your own words

A spacecraft must transmit data to Earth and take pictures in light a human could see. Recommend a band for each job, compare their wavelengths and photon energies, and explain one property both share in empty space.

ANSWER KEY

Invisible Hospital Signals

PART 1 · READ AND MARK

Underline each band name and one property or use linked to it. Circle two facts that all seven bands share. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How do microwave and infrared wavelengths compare, and what different jobs do these bands do at the hospital?	**Microwaves have longer wavelengths than infrared. Hospital Wi-Fi uses microwaves to send data, while an infrared camera detects radiation from warm skin.**
2	Compare the hospital uses of radio waves and X-rays. Which band has more photon energy?	**MRI uses radio-frequency pulses to gather signals from the body. X-rays make images in which bones stand out. X-rays have more photon energy.**
3	Why do bones stand out in an X-ray image, and how does this use differ from the use of gamma rays?	**X-rays pass through soft tissue more easily than bone, so bones stand out in an image. Carefully aimed gamma radiation is used to destroy cancer cells.**
4	Name two properties all seven bands share in a vacuum. Then compare ultraviolet with visible light in wavelength and one effect.	**All seven bands can travel through a vacuum and travel at the same speed there. Ultraviolet has shorter wavelengths than visible light and can damage skin cells.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The spacecraft could use microwaves to transmit data to Earth, as hospital Wi-Fi uses them to send data. It could use visible light to take pictures as human eyes would see them. Microwaves have longer wavelengths and lower photon energies than visible light. Both travel at the same speed in empty space.

For the spacecraft task, accept radio waves instead of microwaves for transmitting data if the student correctly compares them with visible light. Either travel through empty space or equal speed there is a valid shared property.