

Key

## How Sound Moves

1. Can sound be produced in a vacuum? Explain.

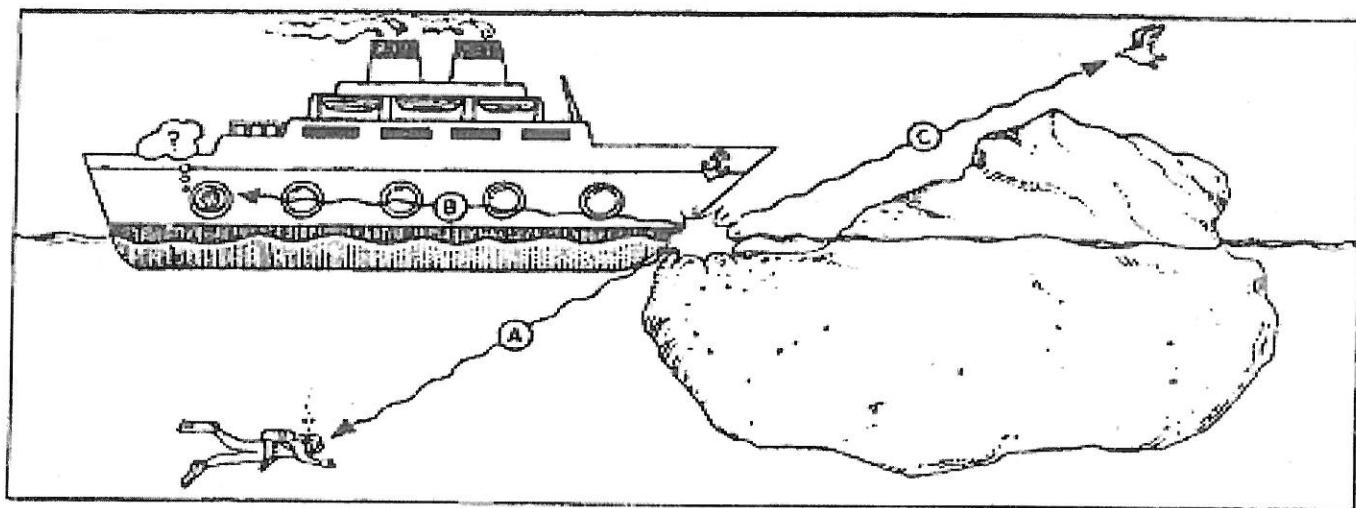
No, because sound requires a medium

2. Describe the relationship between temperature and the speed of sound.

The higher the temperature, the faster sound travels.

3. Contrast loudness and intensity.

Intensity is the energy found in an area, and loudness is determined by intensity.



A passenger ship bumps an iceberg in the middle of the night. The noise of the collision is heard by a scuba diver, a sleeping passenger, and a flying seagull. The three are at an equal distance from the sound.

4. Which one hears the sound first? Explain why.

Sleeping passenger because sound travels fastest through the metal ship.

5. If the ship were made of wood instead of iron, would the passenger hear the bump more quickly or less quickly? Explain why.

Less quickly because wood isn't as dense as metals (iron).

6. Which sound would you expect to have a lower frequency: the roar of an angry lion or the cries of a lost kitten? Explain why, using the term pitch.

The roar of an angry lion because it has a lower pitch, hence a lower frequency + wavelength.

Sound Multiple choice questions

1. What type of wave is a sound wave?  
 A. Compression    B. Transverse
2. The energy of a sound wave is known as the sound's  
 A. Frequency    B. Speed     C. Intensity    D. None of the above
3. The rate of vibration for an object is directly related to  
 A. How hard the object is struck     B. The amount of mass the object has  
 C. None of the above choices
4. Humans perceive sound energy as  
 A. Pitch    B. Frequency     C. Loudness    D. None of the above
5. Humans perceive sound frequency as  
 A. Pitch    B. Intensity    C. Loudness    D. None of the above
6. A sound wave's \_\_\_\_\_ depends on the amount of energy that created it.  
 A. Frequency    B. Pitch     C. Wavelength    D. Amplitude
7. The pitch of a sound wave is determined by the wave's  
 A. Amplitude    B. Quality     C. Frequency    D. Loudness
8. Repeated exposure to loud sounds can cause hearing loss.  
 A. True    B. False
9. Most people can hear sound waves with a frequency between  
 A. 20 to 50,000 hertz    B. 10 to 15,000 hertz  
 C. 20 to 20,000 hertz    D. 20 to 50,000 hertz
10. Can sound waves travel through empty space?  
 A. Yes     B. No
11. How does the state of matter (solid, liquid or gas) affect the rate at which sound travels?  
 A. It has no effect.  
 B. In general, sound waves travel faster in denser substances.  
 C. In general, sound waves travel slower in denser substances.

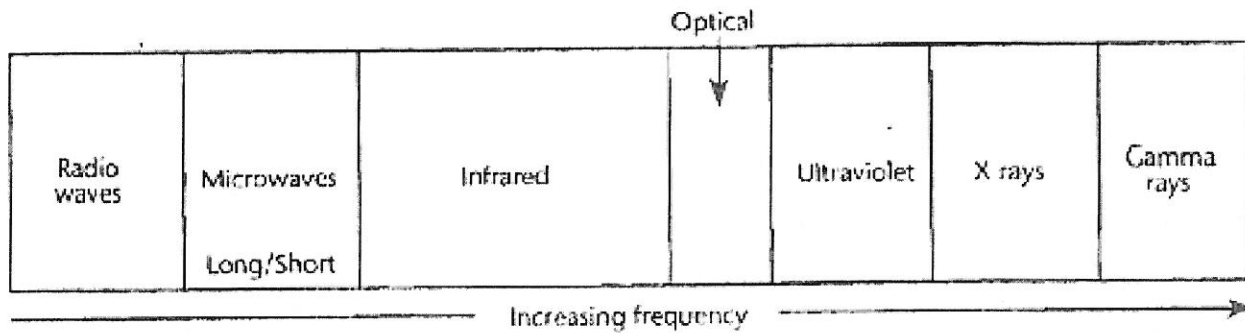
Match each description in Column A with the correct term in Column B. Write the letters of the correct answers in the spaces provided.

COLUMN A	COLUMN B
<u>B</u> 19. Usually given off during nuclear reactions	A. Microwaves
<u>D</u> 20. Sometimes used to kill bacteria	B. Gamma Rays
<u>F</u> 21. Made up of colors of the visible spectrum	C. X-rays
<u>C</u> 22. Can pass through most solid objects	D. Ultraviolet rays
<u>G</u> 23. All objects give off this type of ray	E. Radio waves
<u>E</u> 24. These waves have the longest wavelength and the lowest frequency	F. Light
<u>H</u> 25. Range of electromagnetic wave	G. Infrared rays
<u>A</u> 26. High-frequency radio waves	H. electromagnetic spectrum

**REINFORCEMENT**

**● Electromagnetic Radiation**

Use the diagram to answer questions 1-9.



- C 1. The wavelength of an electromagnetic wave is \_\_\_\_\_ .  
 a. directly proportional to its frequency      c. inversely proportional to its frequency  
 b. inversely proportional to its velocity      d. none of the above
- P 2. In a vacuum, all electromagnetic waves have \_\_\_\_\_ .  
 a. the same frequency      c. the same wavelength  
 b. the same velocity      d. all of the above
- A 3. All electromagnetic radiation in the optical portion of the electromagnetic spectrum \_\_\_\_\_ .  
 a. is visible      c. has the same frequency  
 b. has the same wavelength      d. all the above
- B 4. Compared to the photons of violet light, the photons of red light \_\_\_\_\_ .  
 a. have more energy      c. have equal energy  
 b. have less energy      d. none of the above
- D 5. Compared to radio waves, microwaves have \_\_\_\_\_ .  
 a. shorter wavelengths      c. higher frequencies  
 b. photons with more energy      d. all of the above
- A 6. Compared to gamma rays, X rays have \_\_\_\_\_ .  
 a. longer wavelengths      c. photons with more energy  
 b. higher frequencies      d. all of the above
- C 7. We perceive infrared waves as \_\_\_\_\_ .  
 a. coldness      c. warmth  
 b. light      d. none of the above
- C 8. Compared to gamma rays, radio waves have \_\_\_\_\_ .  
 a. shorter wavelengths      c. photons with less energy  
 b. higher frequencies      d. none of the above
- C 9. All objects emit \_\_\_\_\_ .  
 a. gamma rays      c. electromagnetic waves  
 b. light      d. none of the above

12) Match the kind of Electromagnetic Radiation (on the left) likely to be used in each of the following technologies (on the right). Each Technology may be used only once

Electromagnetic Radiation		Technology	
C	X rays	A.	TV broadcast signals
G	Microwaves	B.	In a hospital to keep surgical equipment sterile
F	Gamma rays	C.	Examining the inside of a weld in a steel oil pipe
A	Radio waves	D.	Lamp used to warm a baby chick
D	Infrared waves	E.	Measuring the speed of a passing car
B	Ultraviolet waves	F.	Used by an oncologist (a physician who studies and treats cancer)
E	Radar	G.	Cell phone

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.

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

14) F Electromagnetic radiation includes only visible light waves.

It includes all of the E.M. Spectrum

15) F Microwaves are a type of infrared wave.

Microwaves are a type of E.M. Radiation

16) F X rays have more energy than gamma rays.

Gamma rays have more energy than x-rays

17) T Radio waves, microwaves and ultraviolet waves all have longer wavelengths than visible light.

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

19) T The Sun radiates both visible energy and invisible energy.

20) F Communicating with satellites is an application of gamma rays.

They communicate using microwaves or radio waves

### Wave Relationship Data (electromagnetic waves):

You should notice a connection between the frequency and the wavelength. Check the data below to confirm this relationship.

Light color	Frequency (in Hertz)	Wavelength (in nanometres, $1\text{nm} = 10^{-9}\text{m}$ )
Violet	$7.69 \times 10^{14}$	390
Blue	$6.12 \times 10^{14}$	490
Green	$5.17 \times 10^{14}$	580
Yellow	$4.84 \times 10^{14}$	620
Orange	$4.17 \times 10^{14}$	720
Red	$3.90 \times 10^{14}$	770

You should notice that by looking at the data for the different colored light waves that a high frequency corresponds to a shorter wavelength and vice-versa.

1. A higher frequency means the wave will have a shorter wavelength. A lower frequency will have a longer wavelength.
2. Which color has the highest wavelength? Red What is its wavelength? 770 nm
3. Which color has the shortest wavelength? Violet What is its wavelength? 390 nm
4. Explain why the rainbow colors are in the order they are.  
They are arranged by length of wave length

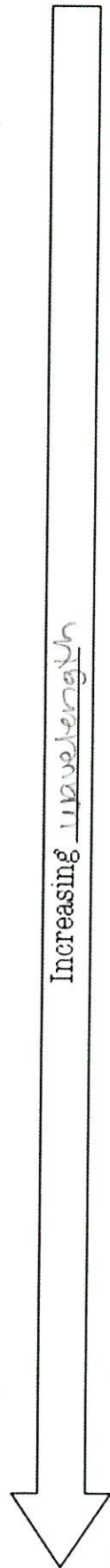
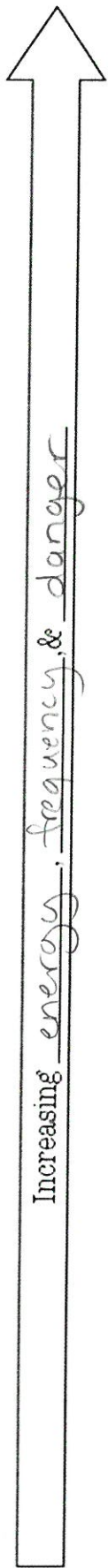
Light is the visible part of the electromagnetic spectrum. The table below gives data on the wavelength and frequency of other parts of the electromagnetic spectrum. Use this data to check that the frequencies and wavelengths obey the same rule that visible light does.

Type of radiation	Frequency (in Hertz)	Wavelength (in cm)
Radio	$< 3 \times 10^9$	$> 10$
Microwave	$3 \times 10^9 - 3 \times 10^{12}$	$10 - 0.01$
Infrared	$3 \times 10^{12} - 4.3 \times 10^{14}$	$0.01 - 7 \times 10^{-5}$
Visible	$4.3 \times 10^{14} - 7.5 \times 10^{14}$	$7 \times 10^{-5} - 4 \times 10^{-5}$
Ultraviolet	$7.5 \times 10^{14} - 3 \times 10^{17}$	$4 \times 10^{-5} - 10^{-7}$
X-rays	$3 \times 10^{17} - 3 \times 10^{19}$	$10^{-7} - 10^{-9}$
Gamma rays	$> 3 \times 10^{19}$	$< 10^{-9}$

1. A higher frequency means the wave will have a shorter wavelength. A lower frequency will have a longer wavelength.
2. Which wave has the highest wavelength? Radio What is its wavelength?  $> 10\text{ cm}$   
Which wave has the shortest wavelength? Gamma ray What is its wavelength?  $< 10^{-9}\text{ cm}$

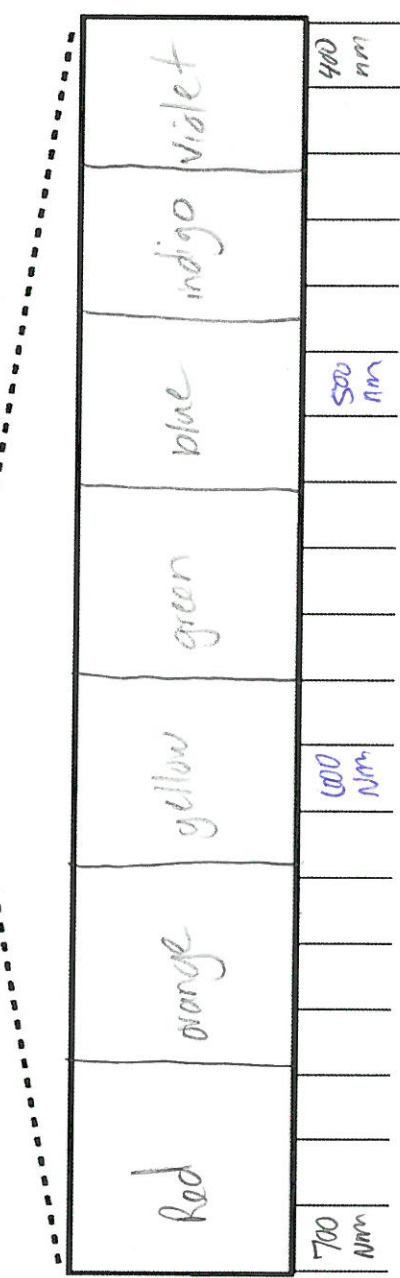
# THE ELECTROMAGNETIC SPECTRUM

The infinite range of frequencies of electromagnetic radiation · an effect of electromagnetism that travels by photon wave particles at the speed of light and carries radiant energy.



<u>Radio waves</u> • communication • AM, FM, TV lowest energy	<u>Microwaves</u> • Wifi • microwave oven	<u>Infrared</u> • Night vision • weather	<u>Visible Light</u> • vision • photography	<u>Ultraviolet</u> • sunburn • dental curing	<u>X-Ray</u> • medical X-ray • baggage screen	<u>Gamma Ray</u> • kill cancer cells • cosmic rays highest energy
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**ROY G. BIV**  
 R = red  
 O = orange  
 Y = yellow  
 G = green  
 B = blue  
 I = indigo  
 V = violet



wavelength →