Sound Across Water

Use wave measurements to test claims about sound.

HS-ICP4-1 "Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves. [Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the wave equation and the sentence about what happens when a wave crosses the water's surface. In the table, circle matching frequencies and box the speeds and wavelengths that differ.

A Tone Above and Below

1. A boat's speaker sends a steady tone that a diver hears underwater. A passenger hears some sound above the surface, too. To compare waves in different places, use speed = frequency × wavelength. Frequency counts cycles per second, measured in hertz (Hz). Wavelength is the distance between matching points on successive cycles, measured in meters (m).

2. The table gives rounded values for sound in air and water. Each row describes a wave traveling through one medium. When a wave crosses the water's surface, its frequency stays the same because the source keeps vibrating at the same rate. Its speed and wavelength can change when the medium changes.

SOUND WAVE MEASUREMENTS

Medium	Frequency (Hz)	Speed (m/s)	Wavelength (m)
Air	500	340	0.68
Water	500	1,500	3.0
Air	1,000	340	0.34
Water	1,000	1,500	1.5

3. Units help test a claim: Hz means cycles per second, so multiplying frequency by wavelength gives meters per second. For example, a wave with a frequency of 200 Hz and a wavelength of 3 m moves at 600 m/s. Do not assume that a higher frequency always means a faster wave. First check whether the medium has changed.

2 ANSWER WITH EVIDENCE

Use the passage

1. Use frequency × wavelength to check the speed in each 500 Hz row. Which medium has the faster sound wave?

2. Compare the two air rows. When frequency doubles, what happens to wavelength? Use both rows' values to support your claim.

3. Compare the 1,000 Hz rows. About how many times larger is the wavelength in water than in air? Compare that factor with the speeds.

4. Predict the wavelength of a 250 Hz sound wave in water. How does it compare with the wavelength of the 500 Hz wave in water?

3 YOUR TURN

Your own words

A speaker sends a 750 Hz tone from air into water. Calculate its wavelength in each medium to the nearest hundredth of a meter, then make a claim about what changes and what stays the same using your calculations as evidence.

ANSWER KEY

Sound Across Water

HIGH SCHOOL · HS-ICP4-1

PART 1 · READ AND MARK

Underline the wave equation and the sentence about what happens when a wave crosses the water's surface. In the table, circle matching frequencies and box the speeds and wavelengths that differ. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Use frequency × wavelength to check the speed in each 500 Hz row. Which medium has the faster sound wave?	**Air: 500 × 0.68 = 340 m/s. Water: 500 × 3.0 = 1,500 m/s. Sound is faster in water.**
2	Compare the two air rows. When frequency doubles, what happens to wavelength? Use both rows' values to support your claim.	**Frequency doubles from 500 to 1,000 Hz while wavelength halves from 0.68 to 0.34 m. Speed stays 340 m/s.**
3	Compare the 1,000 Hz rows. About how many times larger is the wavelength in water than in air? Compare that factor with the speeds.	**1.5 ÷ 0.34 ≈ 4.4. The speed factor is 1,500 ÷ 340 ≈ 4.4, so both wavelength and speed are about 4.4 times larger in water at the same frequency.**
4	Predict the wavelength of a 250 Hz sound wave in water. How does it compare with the wavelength of the 500 Hz wave in water?	**1,500 ÷ 250 = 6 m. That is twice the 500 Hz wave's 3.0 m wavelength in water.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

In air, wavelength = 340 ÷ 750 ≈ 0.45 m; in water, wavelength = 1,500 ÷ 750 = 2.00 m. The frequency stays 750 Hz as the sound enters water, but its wavelength increases because its speed increases from 340 m/s to 1,500 m/s.

Accept equivalent calculations and claims that connect frequency, wavelength, and speed. For the 750 Hz air wavelength, accept 0.45 m when rounded to the nearest hundredth.