Rope Wave Patterns

Use matched trials to investigate how wave properties relate.

PS.2.a "Analyze and interpret data to identify and describe the relationships among wavelength, frequency, amplitude, and energy in waves."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Circle the trial letters for two pairs in the table, one pair with equal frequency and one pair with equal amplitude. Underline the passage rules that help you explain changes in wavelength and energy.

Testing Waves on a Rope

1. At a school concert, a technician tests waves traveling along a stretched rope used in a demonstration. Each trial uses the same rope and tension, so the wave speed stays at 8 meters per second. Frequency counts the crests passing a point each second. Wavelength measures the distance between neighboring crests.

2. The technician changes how quickly the rope end moves and how far it moves from its resting position. That maximum distance is amplitude. The table records the energy carried past one point during one second. Comparing two trials is most useful when one setting stays fixed, allowing the effect of the other setting to stand out.

ROPE WAVE TRIALS

Trial	Frequency (Hz)	Wavelength (m)	Amplitude (cm)	Energy in 1 second (mJ)
A	2	4	1	1
B	4	2	1	4
C	2	4	2	4
D	4	2	2	16

3. On this rope, frequency multiplied by wavelength equals wave speed. The energy carried in the same amount of time also follows a pattern: at a fixed frequency, it grows with the square of amplitude. At a fixed amplitude, it grows with the square of frequency. Use matched trials to test whether the measurements support those patterns.

2 ANSWER WITH EVIDENCE

Use the passage

1. Compare trials A and B. How does wavelength change when frequency doubles on this rope?

2. Compare trials A and C. How does the energy carried in one second change when amplitude doubles?

3. Compare trials C and D. Describe how frequency, wavelength, and energy change while amplitude stays fixed.

4. Trials B and C carry the same energy in one second. How do their frequencies, wavelengths, and amplitudes differ?

3 YOUR TURN

Your own words

Design trial E on the same rope with a frequency of 2 Hz and an amplitude of 3 cm. Predict its wavelength and the energy it carries in one second, then explain both predictions using the table and passage.

ANSWER KEY

Rope Wave Patterns

PART 1 · READ AND MARK

Circle the trial letters for two pairs in the table, one pair with equal frequency and one pair with equal amplitude. Underline the passage rules that help you explain changes in wavelength and energy. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Compare trials A and B. How does wavelength change when frequency doubles on this rope?	**Wavelength decreases from 4 m to 2 m, so it is halved when frequency doubles.**
2	Compare trials A and C. How does the energy carried in one second change when amplitude doubles?	**Energy increases from 1 mJ to 4 mJ, so it quadruples.**
3	Compare trials C and D. Describe how frequency, wavelength, and energy change while amplitude stays fixed.	**Frequency doubles from 2 to 4 Hz, wavelength halves from 4 to 2 m, and energy quadruples from 4 to 16 mJ.**
4	Trials B and C carry the same energy in one second. How do their frequencies, wavelengths, and amplitudes differ?	**Compared with C, B has twice the frequency, half the wavelength, and half the amplitude. Both carry 4 mJ in one second.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Trial E would have a wavelength of 4 m and carry about 9 mJ in one second. Its frequency matches trial A, so its wavelength stays at 4 m. Its amplitude is three times A's amplitude. At a fixed frequency, energy grows with the square of amplitude, so E carries nine times A's 1 mJ.

Accept equivalent comparisons stated as ratios or changes in measured values. For trial E, accept 9 mJ when the student applies the stated square-of-amplitude pattern.