Waves in Motion

Use measurements and models to explain waves in a cord and spring.

PHS.6.1 "Use models to analyze and describe examples of mechanical waves' properties (e.g., wavelength, frequency, speed, amplitude, rarefaction, and compression)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each measurement of wavelength or frequency, circle each description of amplitude, compression, or rarefaction, and number the two places where wave speed is calculated.

A Cord, a Spring, and Two Wave Models

1. At a rehearsal, a technician shakes one end of a long, taut cord while a friend watches a colored knot. The knot moves up and down, but the traveling pattern moves sideways along the cord. The technician measures the distance from one crest to the next as 3 meters. This distance is the wavelength. Two crests pass the knot each second, so the frequency is 2 hertz. A wave travels one wavelength during each cycle. Multiplying wavelength by frequency gives speed, so the pattern travels at 6 meters per second.

2. Next, the technician moves her hand farther up and down without changing how often she shakes the cord. The cord's crests rise higher above its resting position. The greatest distance from that resting position to a crest is the amplitude, so this new wave has a larger amplitude. Its frequency remains 2 hertz. Because the same cord is held at the same tension, the wave's speed stays 6 meters per second, and its wavelength remains 3 meters. A taller crest does not mean the pattern travels faster. If she doubles the shaking rate while keeping the cord equally taut, frequency changes, but speed stays the same.

3. Later, the pair sends a repeated wave through a stretched spring. In this pattern, sections of coils squeezed close together are called compressions, and sections spread farther apart are called rarefactions. The coils move back and forth along the spring while the pattern moves forward. The distance between the centers of two neighboring compressions is one wavelength. They measure this distance as 0.5 meter and count 4 compressions passing a point each second, a frequency of 4 hertz. Multiplying wavelength by frequency gives their model a speed of 2 meters per second. Both waves need a material to carry them.

2 ANSWER WITH EVIDENCE

Use the passage

1. Use the cord model's wavelength and frequency to calculate its wave speed. Show the multiplication.

2. When the technician moves her hand farther but shakes it just as often, which wave property increases? What happens to the wavelength?

3. In the spring model, how do the coils move compared with the wave? Identify where you would find compressions, rarefactions, and one wavelength.

4. Suppose the technician doubles the cord's shaking rate while keeping the same cord and tension. What are the new frequency and wavelength? Use the model's wave speed to explain.

3 YOUR TURN

Your own words

Describe a new model of a wave in a spring. Choose a speed and frequency different from the spring's values in the passage, calculate its wavelength, and explain how your model shows a compression, a rarefaction, and a larger amplitude at the same frequency.

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PART 1 · READ AND MARK

Underline each measurement of wavelength or frequency, circle each description of amplitude, compression, or rarefaction, and number the two places where wave speed is calculated. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Use the cord model's wavelength and frequency to calculate its wave speed. Show the multiplication.	**3 m × 2 Hz = 6 m/s.**
2	When the technician moves her hand farther but shakes it just as often, which wave property increases? What happens to the wavelength?	**Amplitude increases. Wavelength remains 3 meters.**
3	In the spring model, how do the coils move compared with the wave? Identify where you would find compressions, rarefactions, and one wavelength.	**Coils move back and forth along the spring as the wave moves forward. Compressions have closely packed coils, rarefactions have spread-out coils, and one wavelength runs between the centers of neighboring compressions.**
4	Suppose the technician doubles the cord's shaking rate while keeping the same cord and tension. What are the new frequency and wavelength? Use the model's wave speed to explain.	**Frequency becomes 4 Hz. Speed stays 6 m/s, so wavelength is 6 m/s ÷ 4 Hz = 1.5 m.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

My spring wave travels at 3 meters per second and has a frequency of 2 hertz, so its wavelength is 1.5 meters. I mark tightly packed coils as a compression and spread-out coils as a rarefaction. The centers of neighboring compressions are 1.5 meters apart. For a larger-amplitude wave, each coil moves farther from its resting position. I keep the frequency at 2 hertz and the spring unchanged, so the speed and wavelength stay the same.

Accept any consistent speed, frequency, and wavelength, using speed = wavelength × frequency. A larger amplitude in the spring means greater coil displacement from the resting position, not a higher frequency.