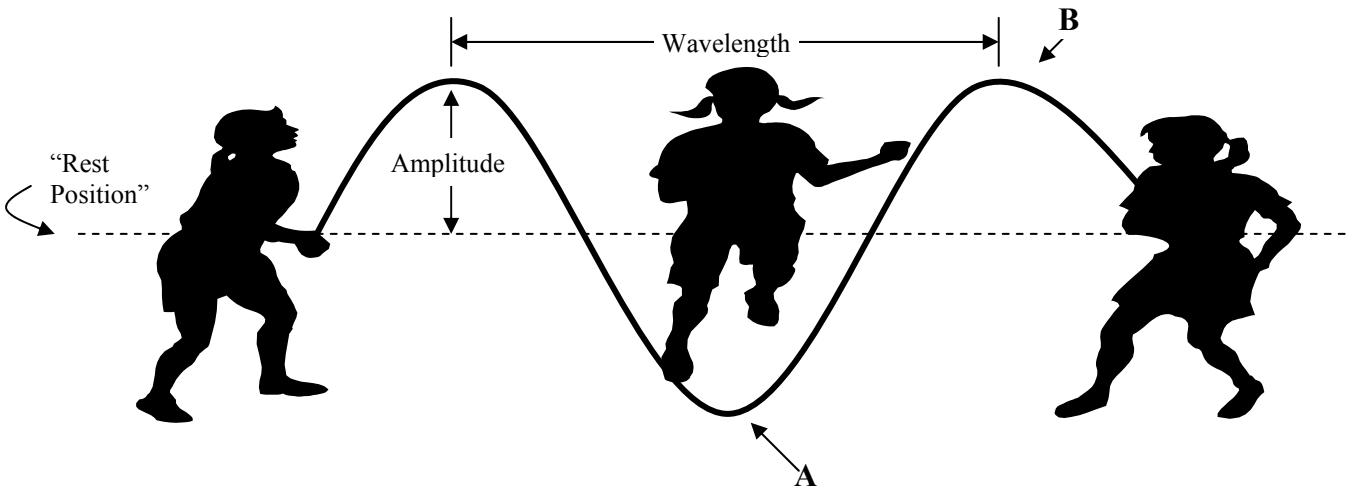
Physics Fix 27 Name: _____

Intro. to Waves

Date: _____
Hour: _____

Information: Waves and Jumping Rope

Figure 1: Three girls playing jump rope. When the girls shake the rope in an up and down motion, the rope takes the shape of a wave.



Critical Thinking Questions

1. Based on Figure 1, define the following terms:

    a) rest position:

    b) amplitude:

    c) wavelength:

2. In Figure 1, there are two arrows (A and B). One of the arrows is pointing to a "crest" and the other is pointing to a "trough". Indicate which arrow is the crest and which is the trough.

3. Obviously, if the girls in Figure 1 did not shake the rope up and down, then there would be no wave. If they move the rope up and down faster, what will happen to the wavelength?

4. Moving the rope up and down faster does not affect the amplitude. How could the girls change the amplitude of their wave?

Information: Frequency of Waves

How fast the girls shake or vibrate the rope will be the frequency of the wave. If one of the girls lifts the rope and brings it back to the rest position once each second, then the frequency is 1 hertz (Hz). The unit of hertz measures the number of complete cycles (back and forth) per second. A frequency of 2 Hz means that the wave vibrates back and forth twice each second.

Critical Thinking Questions

5. Which rope would have the longest wavelength—one with a frequency of 2 Hz or one with a frequency of 3 Hz? Explain.

6. If a wave has a frequency of 2 Hz (two complete cycles per second), how long does it take for the wave to make one complete cycle?

7. If a wave has a frequency of 3 Hz, how long does it take for the wave to make one complete cycle?

8. If a wave has a frequency of 4 Hz, how long does it take for the wave to make one complete cycle?

9. In questions 6-8 you calculated the period of a wave. The period is the time it takes for a wave to make one complete cycle. Which of the following is an equation that can be used to calculate the period of a wave?

A) $\text{period} = \sqrt{\text{frequency}}$ B) $\text{period} = \dfrac{1}{\text{frequency}}$ C) $\text{period} = (\text{frequency})^2$

10. True or false: When the girls make a wave, the rope moves up and down only; the rope does not move left to right.

Information: Motion of Waves

The correct answer for question 10 was TRUE. The rope is simply moving up and down. A *disturbance* in the rope moves left to right, but the rope itself is only moving up and down.

Although the rope itself doesn't move from left to right, we can calculate how fast the disturbance moves in that direction.

Critical Thinking Questions

11. A certain wave has a wavelength of 4 m. If the frequency of the wave was 3 Hz, then 3 complete wavelengths pass by a given point in one second. How many meters of waves pass by a given point in one second?

    A) 4 m B) 7 m C) 12 m D) 1.25 m

12. Given your answer to question 11, what is the speed of the wave? (Remember that speed equals distance traveled divided by time and the time was one second.)

13. Consider a wave that has a wavelength of 5 m. If the frequency was 4 Hz, then calculate the speed of the wave.

14. Given your answers to questions 12 and 13, which of the following is the equation that relates speed (v), wavelength (λ), and frequency (f).

    A) $v = f \bullet \lambda$ B) $v = \frac{f}{\lambda}$ C) $v = \frac{\lambda}{f}$

15. If a water wave vibrates up and down 3 times each second and the distance between wave crests is 2.5 m…

    a) What is the frequency of the wave?

    b) What is the wavelength of the wave?

    c) What is the speed of the wave?

16. Sounds travel to our ears in the form of waves. Sounds that have a high pitch are waves with high frequencies. Sounds that have a low pitch are waves with low frequencies. When you listen to a concert, high notes and low notes both reach your ears at the same time. What can you conclude, therefore, about the speed of waves that have different frequencies?