8.2 Wave Behaviour

KEY TERMS

- wave
- medium
- mechanical wave
- crests
- troughs
- wavelength
- frequency of a wave
- transverse wave
- longitudinal wave
- wave equation

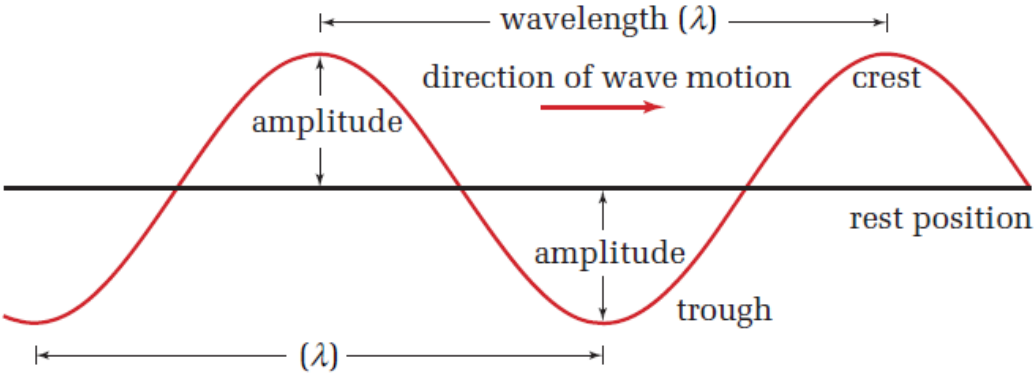

Figure 8.6 This idealized wave illustrates the features that are common to all waves.

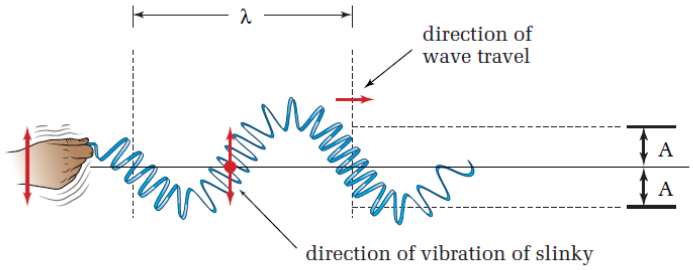

Figure 8.7 When a transverse wave travels along a spring, the segments of the spring vibrate from side to side, perpendicular to the direction of the wave motion.

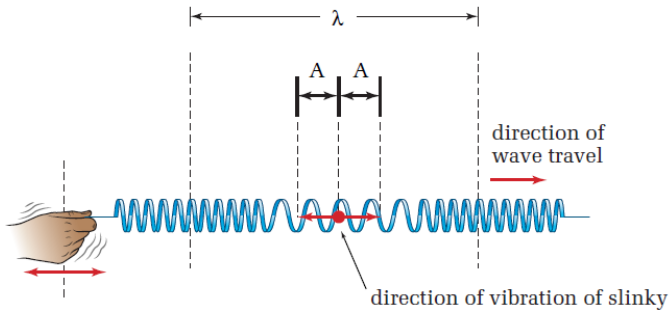

Figure 8.8 When a longitudinal wave travels along a spring, the segments of the spring vibrate parallel to the direction of the wave motion.

Speed, Wavelength, and Frequency: A Universal Wave Equation

Strategy	Calculations
Use the formula for the velocity (or speed) of any entity.	$v = \frac{\Delta d}{\Delta t}$
Substitute in known values.	$v = \frac{\lambda}{T}$
Substitute $\frac{1}{f}$ for T.	$v = \frac{\lambda}{\frac{1}{f}}$
Simplify.	$v = \lambda f$

The speed of a wave is the product of its wavelength and its frequency: $v = \lambda f$.

THE WAVE EQUATION

The speed of a wave is the product of the wavelength and the frequency.

$$v = f\lambda$$

Quantity	Symbol	SI unit
speed	v	$\frac{\text{m}}{\text{s}}$ (metres per second)
frequency	f	Hz (or s^{-1})(hertz)
wavelength	λ	m (metres)

Unit Analysis

(frequency)(wavelength) = Hz m = s^{-1} m = $\frac{\text{m}}{\text{s}}$

A physics student vibrates the end of a spring at 2.8 Hz. This produces a wave with a wavelength of 0.36 m. Calculate the speed of the wave.

$$v = f\lambda$$
$$= 2.8 \cdot .36$$
$$= 1.008 \text{ m/s}$$

Water waves with wavelength 2.8 m, produced in a wave tank, travel with a speed of 3.80 m/s. What is the frequency of the device that produced them?

$$v = f\lambda$$

$$\frac{3.8}{2.8} = \frac{2.8f}{2.8}$$

$$1.36\,Hz = f$$