

a wave carries energy through a medium, the medium's own particles never actually travel with it

What a mechanical wave is *

- a disturbance carrying energy through a medium; the particles do not go along
- needs an elastic medium to restore itself, and inertia to carry the disturbance on
- a mechanical wave cannot cross a vacuum; light needs no medium at all
- each particle only oscillates about its own fixed mean position as the wave passes

Wave basics

speed, frequency and wavelength

$$v = f\lambda$$

angular frequency

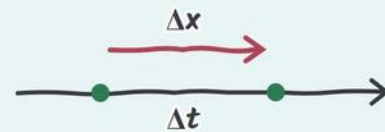
$$\omega = 2\pi f = \frac{2\pi}{T}$$

wave number

$$k = \frac{2\pi}{\lambda}$$

displacement, wave moving along +x

$$y = a \sin(kx - \omega t)$$



a crest moves a distance Δx in a time Δt , wave speed is just that ratio

v is set by the medium, f is set by the source, and λ is whatever v/f works out to be

Transverse vs longitudinal

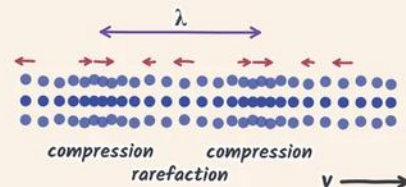
Transverse



beads on a string: each moves only up and down on its own track (arrows), none at a crest or trough, while the wave moves on at v

- particles move **perpendicular** to the direction the wave travels
- crests and troughs, a wave on a stretched string is the classic case

Longitudinal



beads in a line: each moves only back and forth (arrows), bunching into compressions and spreading into rarefactions that move on at v

- particles move **along the same line** as the direction the wave travels
- compressions and rarefactions, sound in air is the classic case

a transverse wave needs a medium that resists shear, that's why sound in a gas can only ever be longitudinal