Waves

A wave is the motion of a disturbance.

Medium - environment through which a disturbance can travel

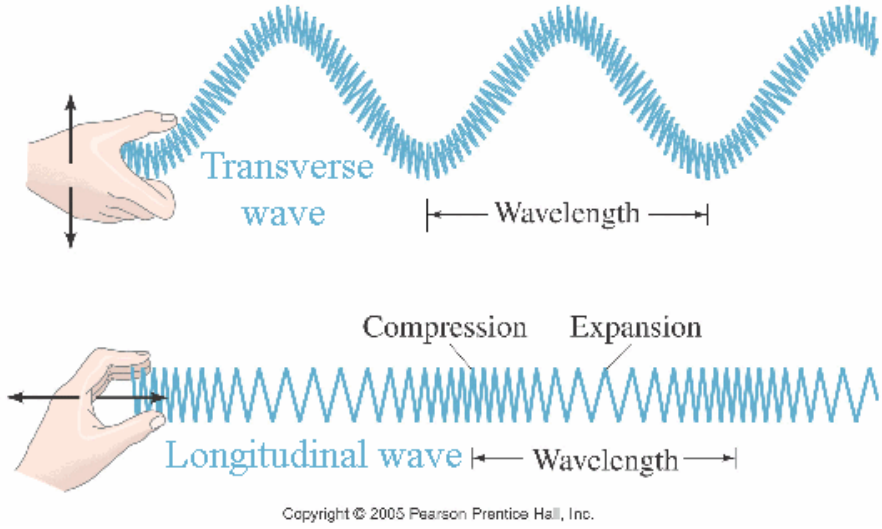
Mechanical waves - require a medium to travel (ie: sound)

Electromagnetic waves - do not require a medium to travel
(ie: visible light, microwaves, X rays)

Wave Types:

Transverse waves - vibrations are perpendicular to the wave direction (ie. electromagnetic waves)

Longitudinal waves - vibrations are parallel to the waves motion (ie. sound)


Transverse
wave
Wavelength
Compression
Expansion
Longitudinal wave
Wavelength
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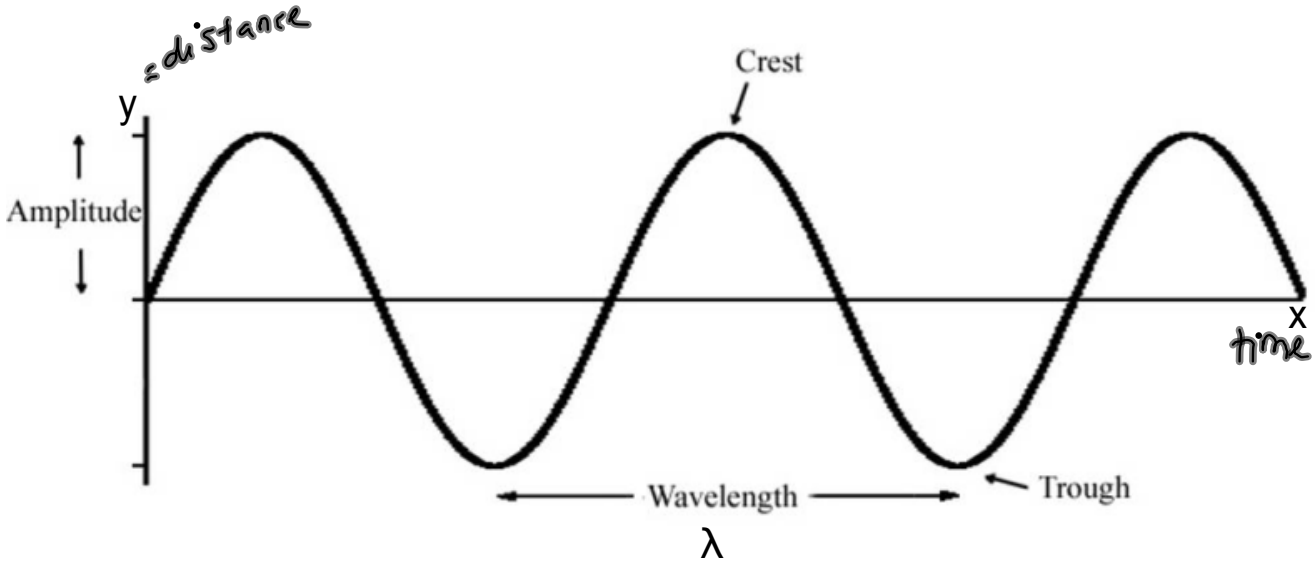
Parts of a Wave



Speed of a Wave:

$$v = f \lambda$$

v = velocity (m/s)
f = frequency (s^{-1} or Hz)
λ = wavelength (m)

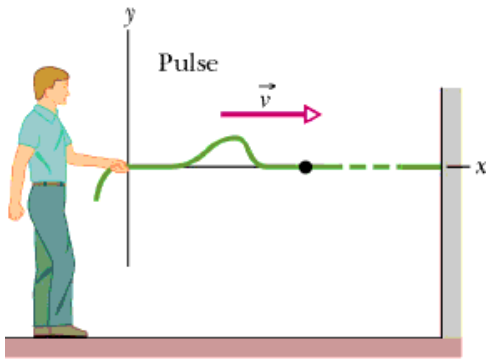
Example 1: The wavelength of red light is 5×10^{-7} m. The speed of light is 3.0×10^{8} m/s. Find its frequency.

$$v = f\lambda$$

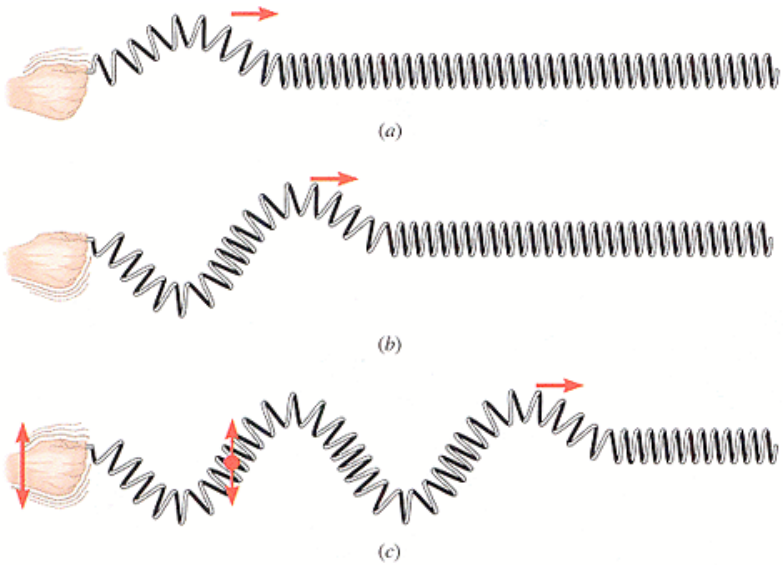
$$3 \times 10^{8} = f(5 \times 10^{-7})$$

$$f = 6 \times 10^{14}\ Hz$$

Pulse wave - a single traveling wave

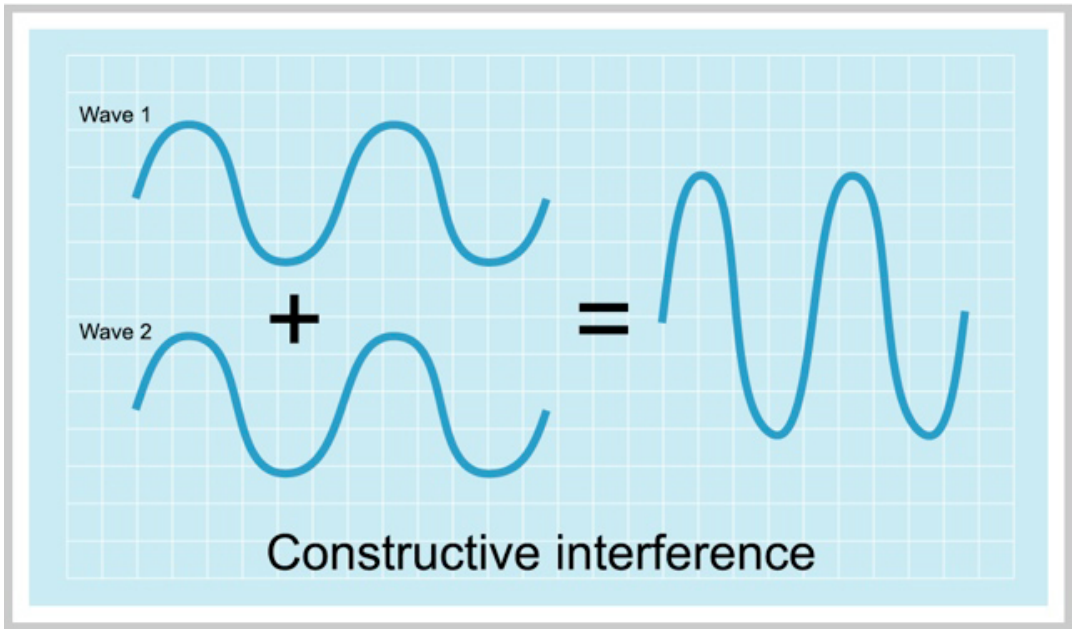


Periodic wave - generating a series of waves



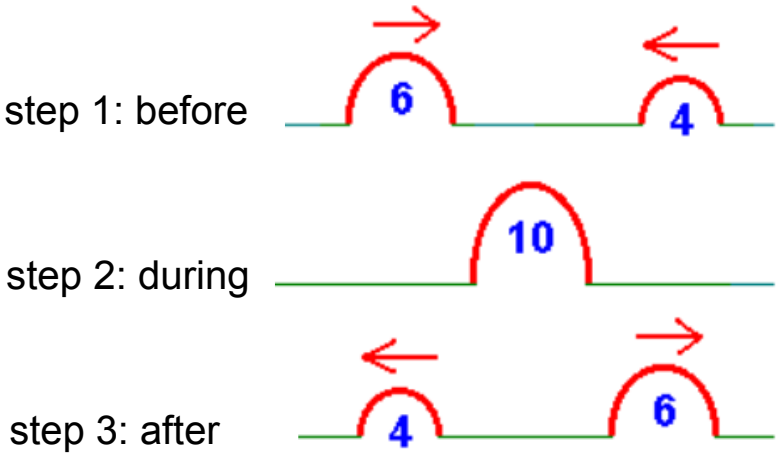
Wave Interactions

Displacements in the same direction produce **constructive interference**.

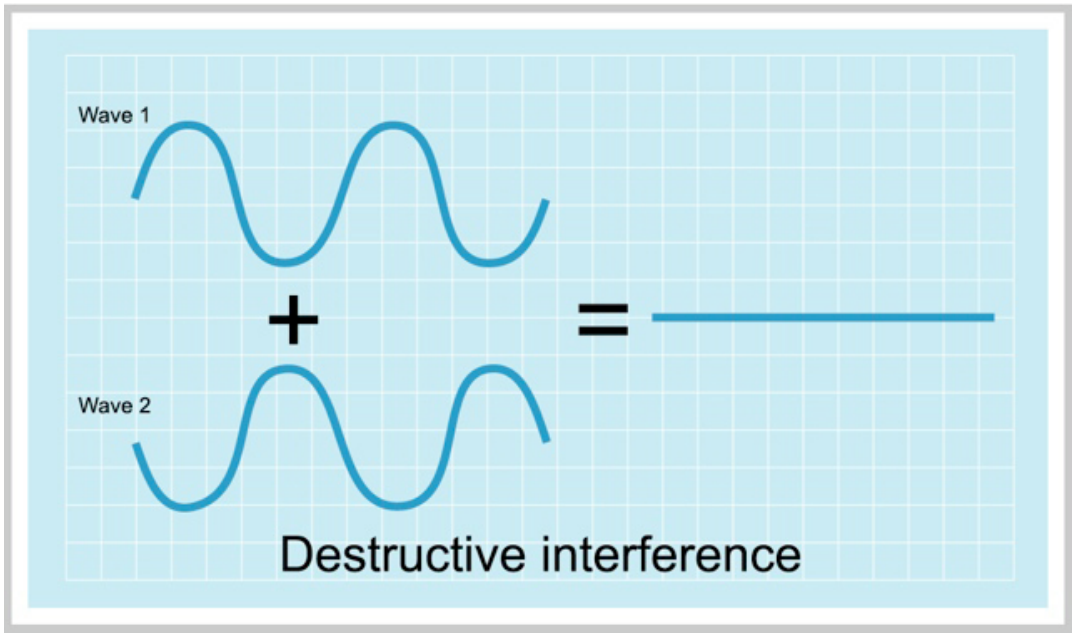


For constructive interference, the pulses are ADDED together!

Both waves are on the same side of the equilibrium.

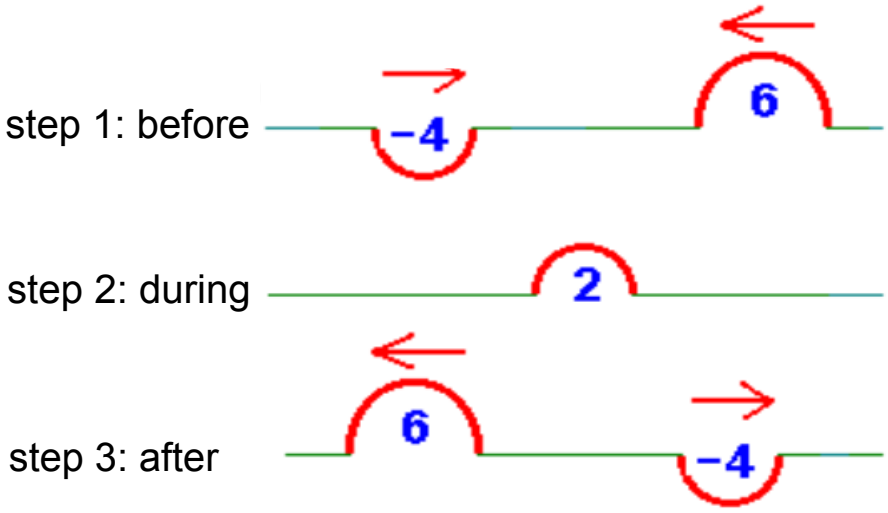


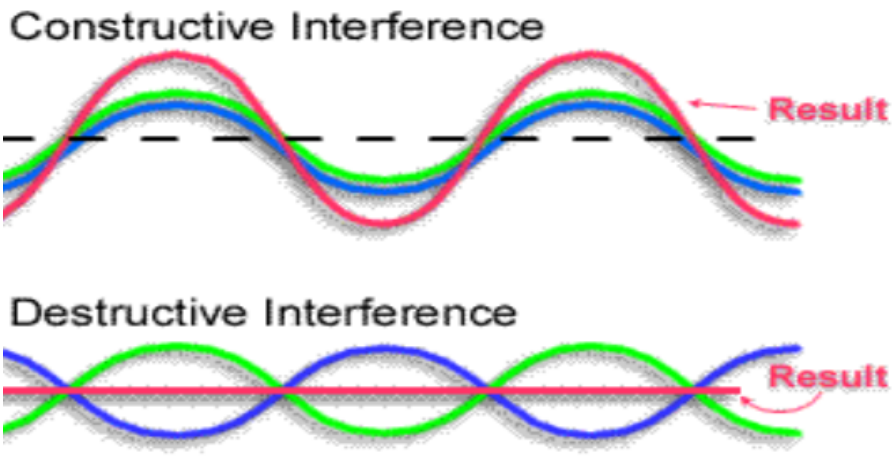
Displacements in the opposite direction produce **destructive interference**.



For destructive interference, take the DIFFERENCE of the pulses!

The waves are on opposite sides of the equilibrium.




Constructive Interference
Result
Destructive Interference
Result

Reflection of Waves

- At a fixed boundary, waves are **reflected** and **inverted**.
- At a free boundary, waves are solely **reflected.** (no inversion)

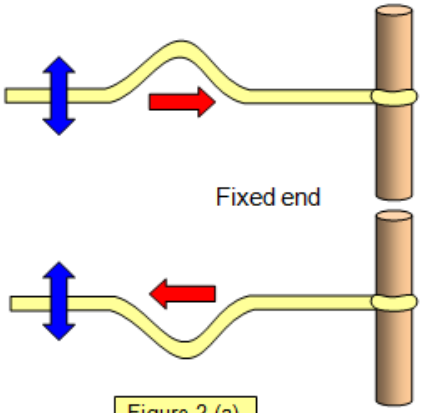


Figure 2 (a)

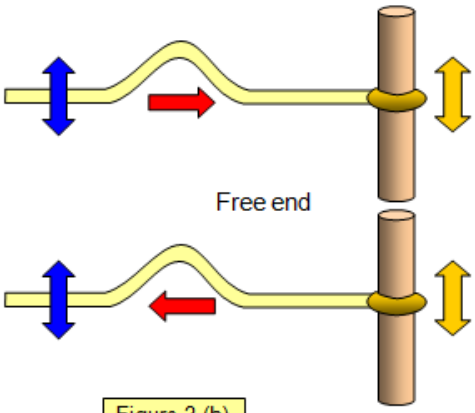


Figure 2 (b)

A) The free end pulse the end of the cord moves up the rod as the wave meets it. The movement can then produce a reflected pulse.

B) The fixed end pulse causes the end of the cord to exerts an upward force on the rod. By Newton's Third Law the rod therefore exerts a downward force on the cord causing the reflected pulse experiences a change of phase.

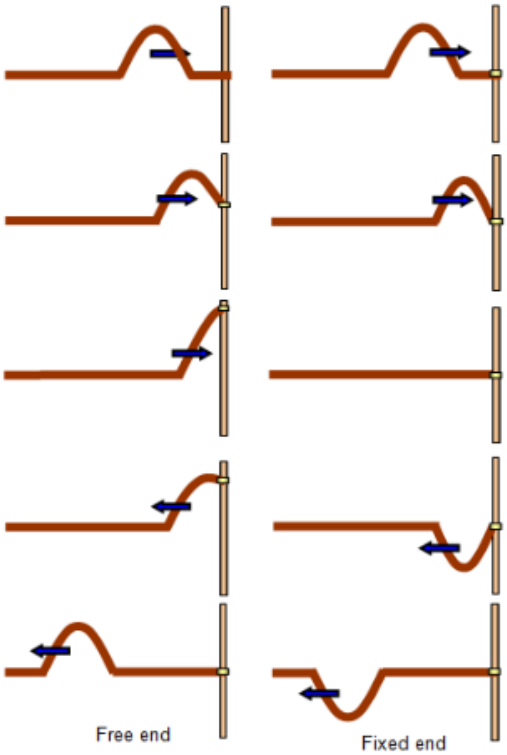


Figure 3