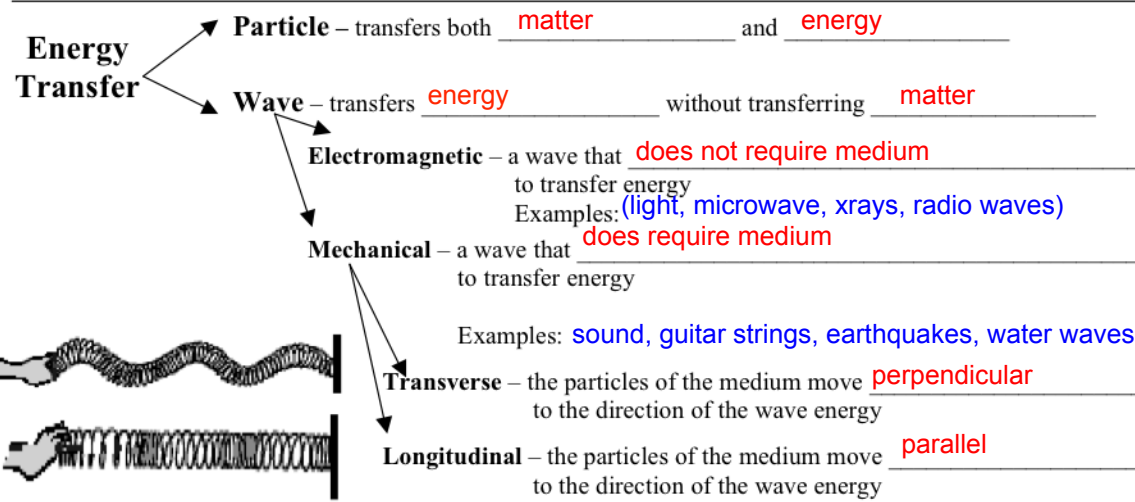


Waves

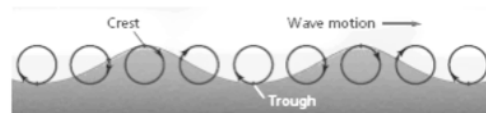
1. medium the material through which the wave (energy) is traveling
2. pulse a single oscillation or disturbance of the medium
3. traveling wave a series of pulses or oscillations that move through a medium



4. Other types of mechanical waves

Elliptical wave (surface wave): – ex: water waves
combination of transverse and longitudinal

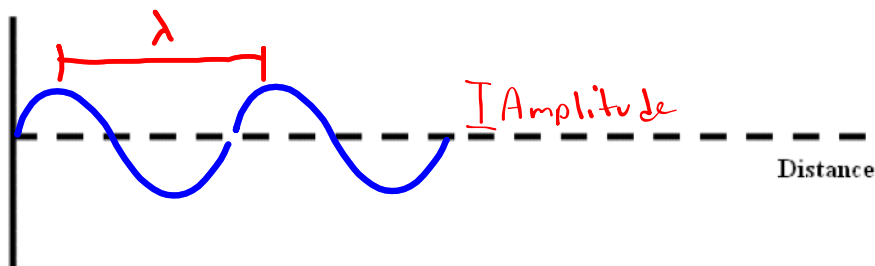
Torsional wave:
twisting wave



Wave Characteristics

Cycle: one complete oscillation or vibration

5. On the **Vertical position** axes at right, sketch two cycles of a transverse wave.



6. Label the following parts of the wave you drew: **equilibrium position, crest, trough, amplitude, wavelength**

7. Identify each of the following terms:

- a) Amplitude maximum displacement from the equilibrium position
- b) wavelength shortest distance along the wave between two points that are in phase
- c) period time taken for one cycle
- d) frequency number of cycles per second

Symbol	Units
A, X	[m]
λ	[m]
T	[s]
f or ν	[s ⁻¹] = [Hz]

8. What is the relationship between period and frequency?

Period **Relationship**

$T = \frac{\text{sec}}{\text{cycle}}$ $f = \frac{\text{cycles}}{\text{sec}}$ $T = \frac{1}{f}$

Frequency

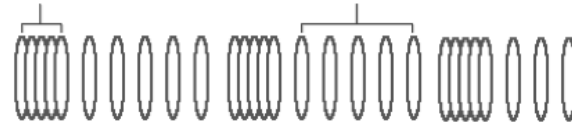
Examples:

greek letter 'nu'

9. Name each part of the longitudinal wave shown at right. Indicate the amplitude and wavelength of the wave.

compressions

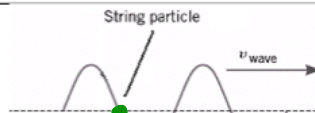
rarefactions



<http://surendranath.tripod.com/Applets.html>

Wave Motion vs. Particle Motion

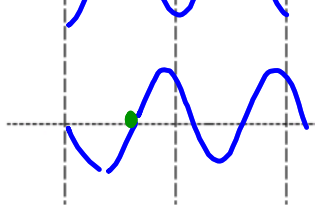
a) In which direction is the string particle moving at this instant?



b) Sketch the wave and particle after 1/4 of a period from the time shown in a).



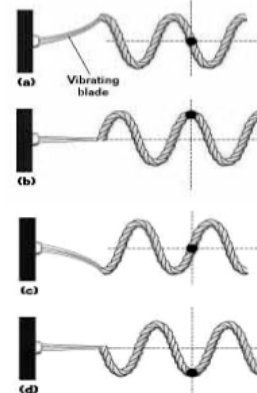
c) Sketch the wave and particle after 1/2 of a period from the time shown in a).



d) How far will the wave energy travel in one period? 1λ

e) How long does it take one complete cycle to pass a given point? $1 T$

Compare the motion of the wave with the motion of a single particle of the medium.



Wave (energy) motion

const. speed

Particle motion

SHM

Determining the Speed of a Wave

Derivation

$$V = d/t$$

$$V = \lambda/T$$

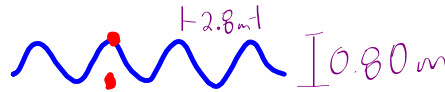
$$V = \lambda \cdot f$$

The Wave Equation

$$v = \lambda \cdot f$$

Variable:	v	λ	f
Quantity:	speed	wavelength	frequency
Units:	[m/s]	[m]	[s ⁻¹]
Type:	scalar	scalar	scalar

1. A buoy moored off-shore bobs up and down as waves pass by. A nearby boater notices that it takes 1.6 seconds for the buoy to move from its lowest position to its highest position, a distance of 0.80 meters. She also notices that the crests of the waves are approximately 2.8 meters apart.



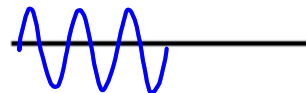
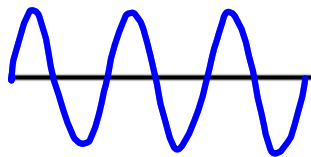
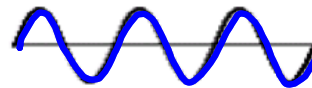
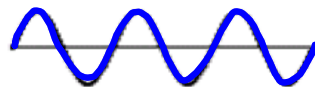
a) What is the average speed of the buoy?

$$V_{avg} = d/t = \frac{0.80m}{1.6s} = .5m/s$$

b) What is the average speed of the wave?

$$T = 3.2s$$

$$V = \lambda \cdot f = \frac{2.8m}{3.2s} \approx .88m/s$$



2. a) On the bottom, sketch a wave that has the same wavelength as the wave on top but a higher amplitude.

b) A mechanical wave with a higher amplitude has more . . .
energy

c) Will increasing the amplitude change the speed of the wave?

no

4. How can the speed of a wave be changed?

change medium

3. a) On the bottom, sketch a wave that has the same amplitude as the wave on top but a higher frequency.

b) A wave with a higher frequency has a . . .
shorter period

c) Will increasing the frequency change the speed of the wave?

no

Sound Waves

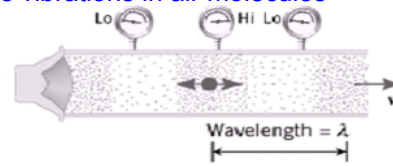
1. How are sound waves produced? **a vibrating object produces vibrations in air molecules**

2. What type of a wave is sound?

- a) **mechanical**
- b) **longitudinal**

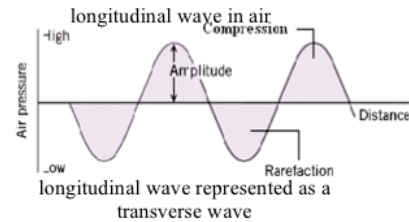


longitudinal wave in a Slinky



3. How can a longitudinal wave be represented as a transverse wave?

compressions = peaks
rarefactions = troughs

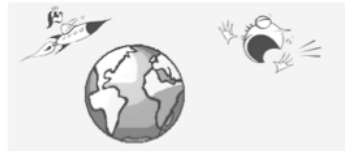


4. What happens when this wave of varying air pressure reaches your ear?

vibrations of ear drum ... send electrical signal to brain



5. Can sound be heard in outer space? Explain.



no, there's no medium for sound to travel through

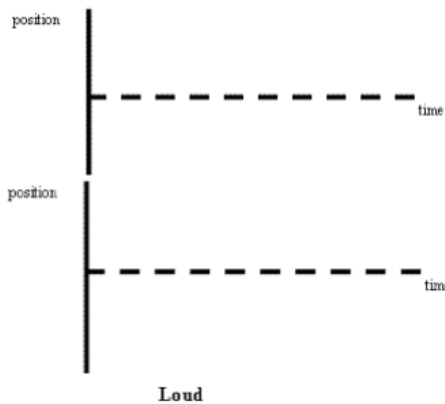
6. Speed of sound in air at STP:

7. Speed of sound in air at room temp:

8. How is the speed of sound related to air temperature? Explain.

9. Does sound travel fastest in a solid, a liquid, or a gas?

10. As you increase the loudness (volume) of a sound, you increase its . . .



11. As you increase the pitch of a sound, you . . .

