

## L01 - Waves and Wave Equation

### Agenda:

- Attendance
- Two Types of Waves
  - Slinky Challenge - Two Types of Waves?
  - Types of Waves
  - Wave Race
- **HAND OUT LESSON**
- Wave Terminology
  - Matching section will be included on your first Summative Quiz!
- Wave Equation
$$v = f\lambda \quad T = \frac{1}{f}$$
- Sound and Light Waves

### Additional Time?

- Decibel Scale
- Triangulation Discussions
  - Lightning Strikes (Light and Sound Waves)
  - Earthquakes (S- and P-Waves)
  - The Liquid Core of the Earth
- Videos
  - MSN: Hollow Earth Theory
  - VSauce: Flat Earth Theory
  - Neal Adams: Expanding Earth Theory

## Slinky Demo: Transverse and Longitudinal Waves

### Activity:

- Students split into groups of 3.
- One slinky per group.
- Slinky's are laid on the floor.
- Students must find two ways to create a wave that will propagate from one end of the slinky to the other.

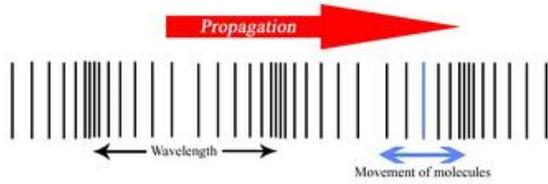
## Race: Transverse and Longitudinal Waves

### Activity:

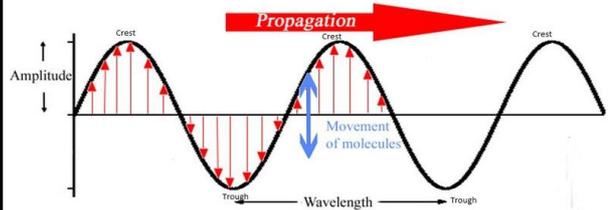
- Students form into 2 lines, side by side.
- Each line will be instructed on how to propagate their wave (Transverse or Longitudinal).
- Students will race to see which wave propagates the fastest.

# Types of Waves

## Longitudinal Waves

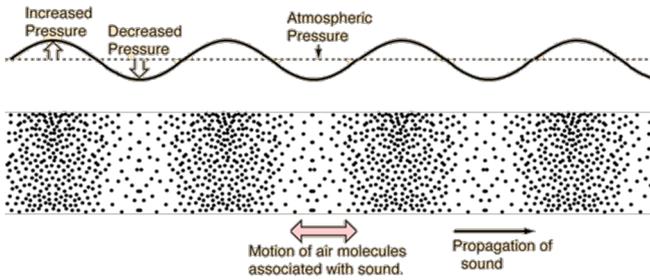


## Transverse Waves



## Longitudinal Examples

### SOUND WAVES

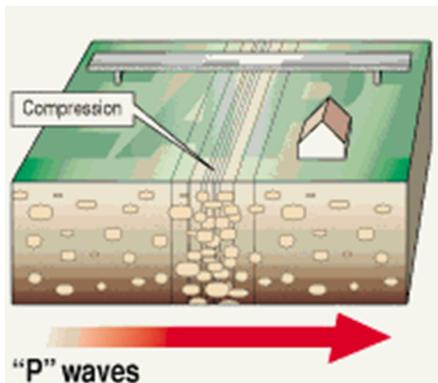


## Transverse Examples

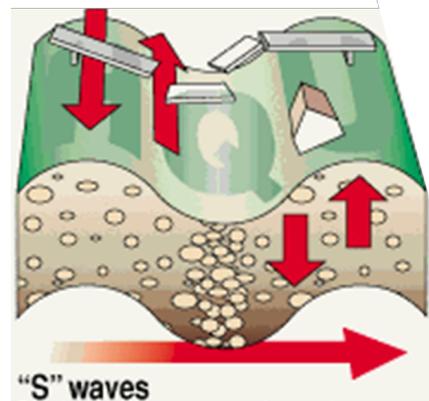
### WATER WAVES



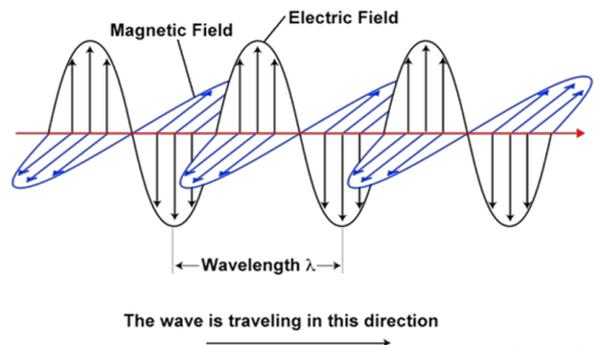
### EARTHQUAKE PRIMARY WAVES



### EARTHQUAKE SECONDARY "SHEAR" WAVES

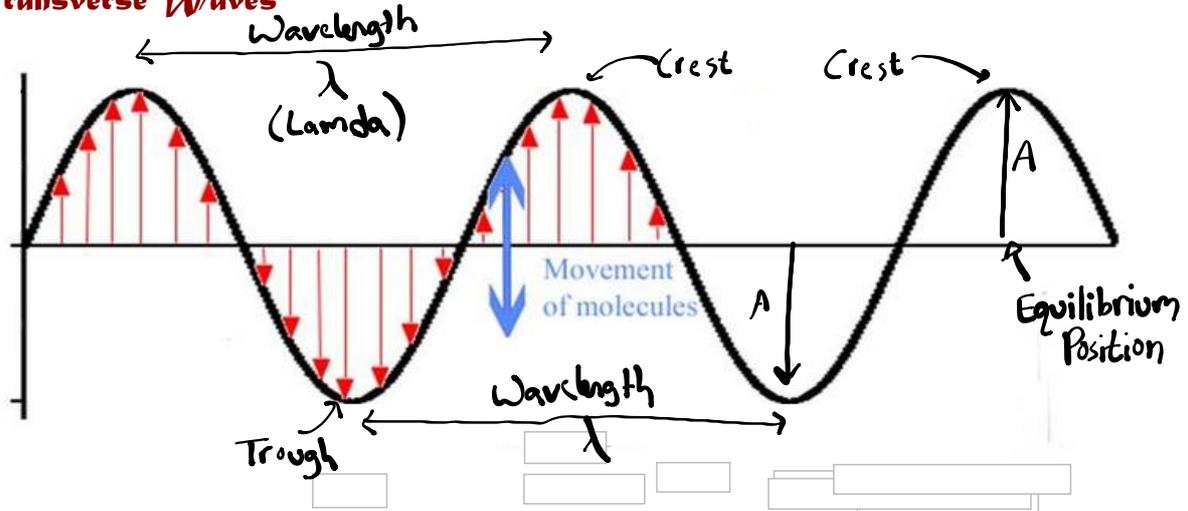


### LIGHT WAVES



# Wave Terminology

## Transverse Waves



**Equilibrium Position:** Rest position of a medium.

**Crest:** Region where the medium rises above the equilibrium position.

**Trough:** Region where the medium is lower than the equilibrium position.

**Amplitude:** The distance from the equilibrium position to the top of a crest. Also the distance from the equilibrium position to the bottom of a trough.

**Wavelength:** The distance between two points on a wave that have identical status. Most commonly measured from crest to crest or from trough to trough.

**Direction of Propagation:** The direction of the wave movement, not particle movement.

## Longitudinal Waves



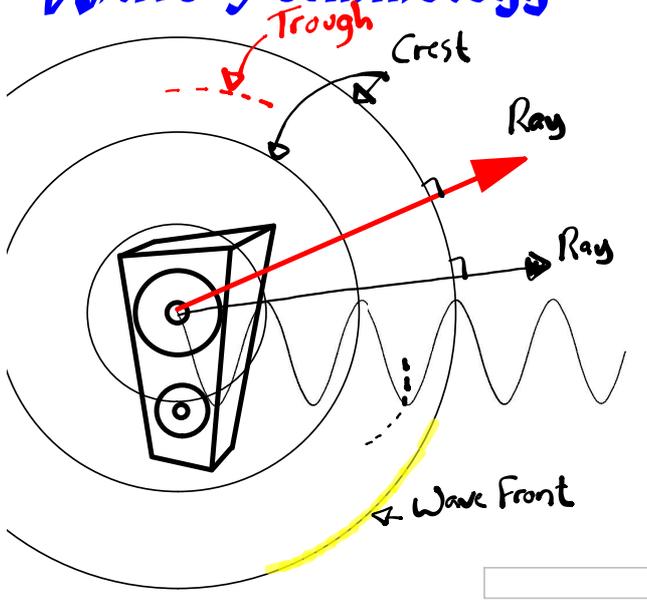
**Compression:** A region in a longitudinal wave where the particles are closest together.

**Rarefaction:** A region in a longitudinal wave where the particles are furthest apart.

**Wavelength:** The distance between two points on a wave that have identical status. Most commonly measured from compression to compression.

**Direction of Propagation:** The direction of the wave movement, not particle movement.

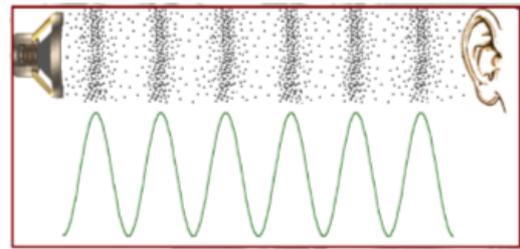
# Wave Terminology



Circular lines represent **crests.**

In between circular lines represent **troughs.**

The center of the circles represent a **point source.**



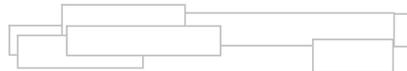
**Point Source:** A single point of **disturbance** that generates a **circular wave.**

**Wave Front:** An imaginary **line** that joins all **points** reached by the wave at the **same instant.**

**Wave Train:** A series of waves forming a **continuous series** of crests and troughs.

**Ray:** A line that indicates only the **direction** of motion of the wave front from any point where the ray and the wave **intersect.**

**Divergent Rays:** Rays that **spread out** as they move **away** from the origin.



# Wave Equation

$$v = f\lambda$$

↑ Freq (Hz)  
 ↓ Speed (m/s)      ↓ Wavelength (m)

$$T = \frac{1}{f}$$

Given on a test

Speed of sound (0°C) = 331.3 m/s

Speed of sound (20°C) = 343.3 m/s

Speed of light =  $3.0 \times 10^8$  m/s

↳ on formula sheet

Q1: To generate waves in a stretched spring you oscillate your hand back and forth at a frequency 2.00 Hz. If the speed of the waves in the spring is 5.40 m/s what is the wavelength?

$$f = 2 \text{ Hz}$$

$$v = 5.4 \text{ m/s}$$

$$\lambda = ?$$

$$v = f\lambda$$

$$5.4 = (2)\lambda$$

$$\lambda = 2.7 \text{ m}$$

Q2: The period of vibration for a  $4.0 \times 10^{-7}$  m light source is

- a.  $1.3 \times 10^{-15}$  s
- b.  $3.0 \times 10^{-8}$  s
- c.  $1.2 \times 10^2$  s
- d.  $7.5 \times 10^{14}$  s

$$\lambda = 4.0 \times 10^{-7} \text{ m}$$

$$v = 3.0 \times 10^8 \text{ m/s}$$

(A)  $v = f\lambda$

$$3.0 \times 10^8 = f(4.0 \times 10^{-7})$$

$$f = 7.5 \times 10^{14} \text{ Hz}$$

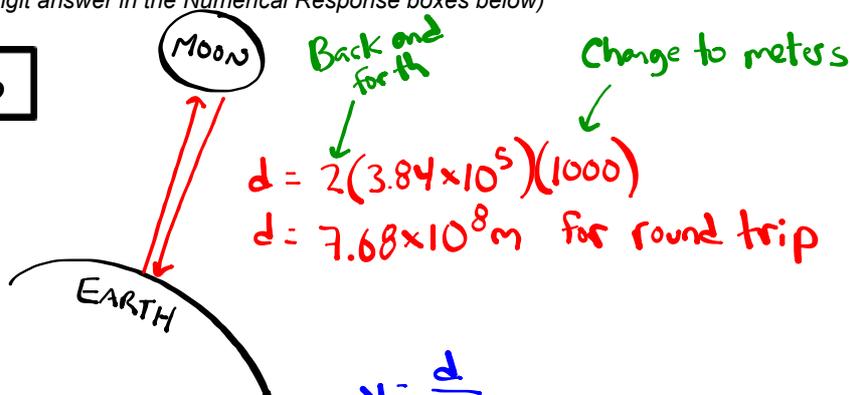
(B)  $T = \frac{1}{f}$

$$T = 1.3 \times 10^{-15} \text{ s}$$

Q3: The distance from the Earth to the moon is  $3.84 \times 10^5$  km. Using infra-red radiation, the time required for a signal to go to the moon and to return is \_\_\_\_ s.

(Record your three digit answer in the Numerical Response boxes below)

2	.	5	6
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$$d = 2(3.84 \times 10^5)(1000)$$

$$d = 7.68 \times 10^8 \text{ m for round trip}$$

$$v = \frac{d}{t}$$

$$t = \frac{d}{v} = \frac{7.68 \times 10^8}{3.0 \times 10^8} = 2.56 \text{ s}$$

## **Practice**

Pg 409 #1-3