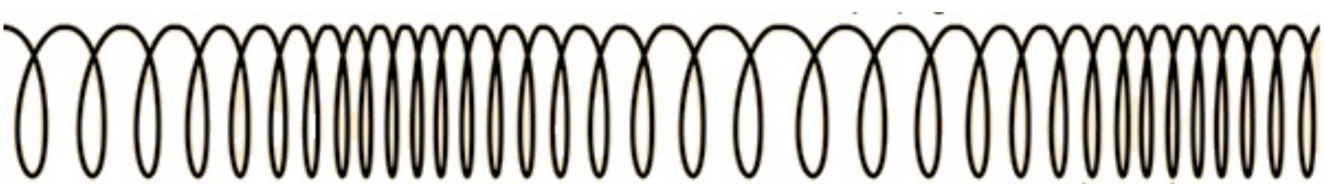
SOUND

"With trumpets and the sound of a horn; Shout joyfully before the LORD, the King." Psalm 98:6

- a wave can be described as a disturbance that travels through a medium, transporting energy from one location to another location
- the medium is simply the material through which the disturbance is moving; it can be thought of as a series of interacting particles
- the example of a slinky wave is often used to illustrate the nature of a wave:
  1) a disturbance is typically created within the slinky by the back and forth movement of the first coil of the slinky --> the first coil becomes disturbed and begins to push or pull on the second coil, which displaces the second coil from its equilibrium position
  2) as the second coil becomes displaced, it begins to push or pull on the third coil --> the push or pull on the third coil displaces it from its equilibrium position
  3) as the third coil becomes displaced, it begins to push or pull on the fourth coil. This process continues, with each individual particle acting to displace or move the adjacent particle. Subsequently the disturbance travels through the slinky.
- As the disturbance moves from coil to coil, the energy that was originally introduced into the first coil is transported along the medium from one location to another.

Longitudinal waves

· waves in which particles of the transmitting medium oscillate back and forth in the same direction that the wave moves (ex. spring, sound waves)
· direction of movement: ---------->
· compression pulse and rarefaction pulse consists of portion of the spring in which the coils are compressed then spread out; compression pulse and rarefaction pulse add together to constitute single longitudinal wave
· compression pulse = crest of transverse wave, rarefaction wave = trough
· wavelength = rarefaction to rarefaction or compression to compression



rarefaction compression rarefaction compression

I---I
wavelength
OR
I---I
wavelength

Sound waves

- a sound wave is similar in nature to a slinky wave for a variety of reasons
- there is a medium that carries the disturbance from one location to another; the medium is simply a series of interconnected and interacting particles
- there is an original source of the wave, some vibrating object capable of disturbing the first

particle of the medium. The disturbance could be created by the vibrating vocal cords of a person, the vibrating string and soundboard of a guitar or violin, the vibrating tines of a tuning fork, or the vibrating diaphragm of a radio speaker.

- the sound wave is transported from one location to another by means of particle-to-particle interaction. If the sound wave is moving through air, then as one air particle is displaced from its equilibrium position, it exerts a push or pull on its nearest neighbors, causing them to be displaced from their equilibrium position.
- since a sound wave is a disturbance that is transported through a medium via the mechanism of particle-to-particle interaction, a sound wave is characterized as a mechanical wave.

Speed of sound

- like any wave, the speed of sound refers to how fast the disturbance is passed from particle to particle
- since the speed of a wave is defined as the distance that a point on a wave travels per unit of time, it is often expressed in units of meters/second:

speed = distance/time

- The faster a sound wave travels, the more distance it will cover in the same period of time.
- The phase of matter has a tremendous impact on the medium. In general, solids have the strongest interactions between particles, followed by liquids and then gases. For this reason, longitudinal sound waves travel faster in solids than they do in liquids than they do in gases.
- At normal atmospheric pressure, the speed of sound through dry air is influenced by temperature according to the following equation:

$$v = 331 \text{ m/s} + (0.6)xT$$

where v=velocity of sound

T = temperature of the air in °Celsius

Let's practice!

1. If a sound wave were observed to travel a distance of 700 meters in 2 seconds, what is the speed of the wave?

speed = distance / time = 700m / 2s = 350 m/s

2. What is the speed of sound in air that is 20°C?

$$v = 331 \text{ m/s} + (0.6)xT$$

$$v = 331 \text{ m/s} + (0.6)x(20°C)$$

$$v = 331 \text{ m/s} + 12 \text{ m/s}$$

$$v = 343 \text{ m/s}$$

***be sure to multiply 0.6 x T BEFORE you add 331**