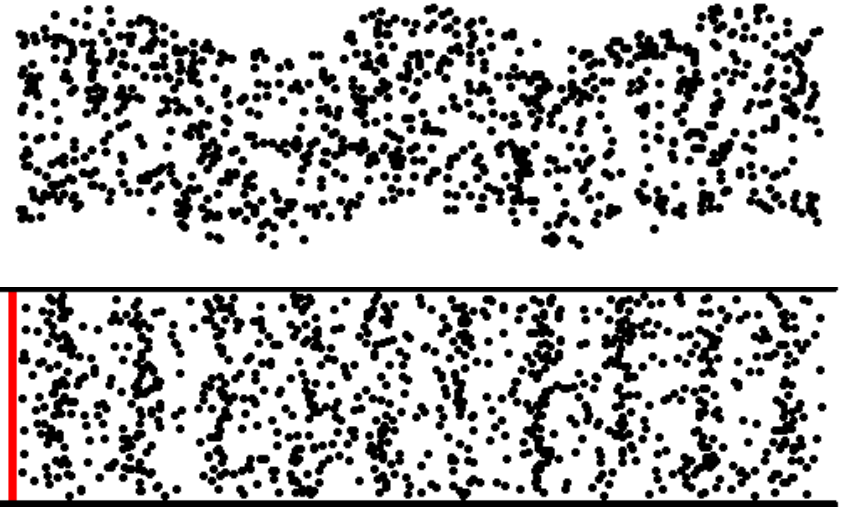
WAVES

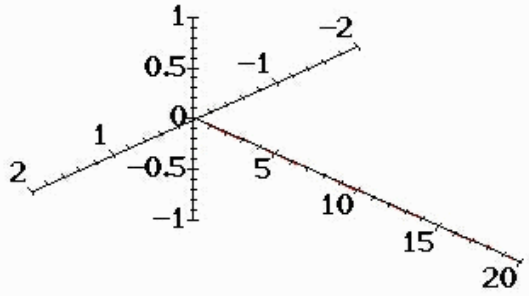
Waves

- **Waves**
  - **Are disturbances** that move through an empty space or through medium (material)
  - **transfer energy** without transferring matter.
  - Particles of medium **move in simple harmonic motion**

Mechanical: Through a medium



Electromagnetic: Through empty space

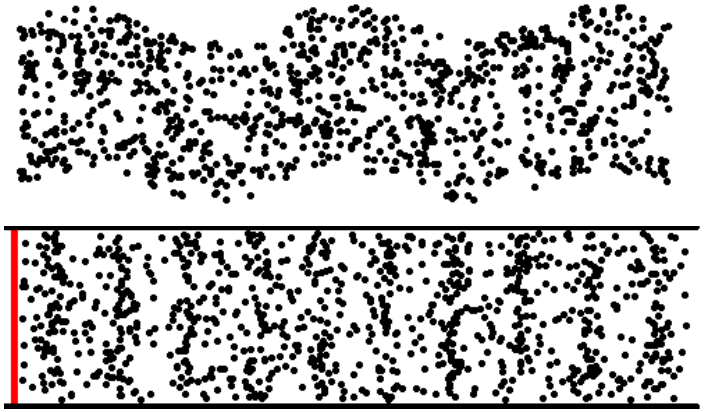


Mechanical Wave

- **Mechanical wave**:
  - Caused by a disturbed medium and move by action reaction of particles.
  - ex: water wave, sound

- A **medium** is matter particles like gas (ex. air), liquid (ex. Water), and solid (ex. earth)

Two types of mechanical waves that require a medium



Transverse Wave

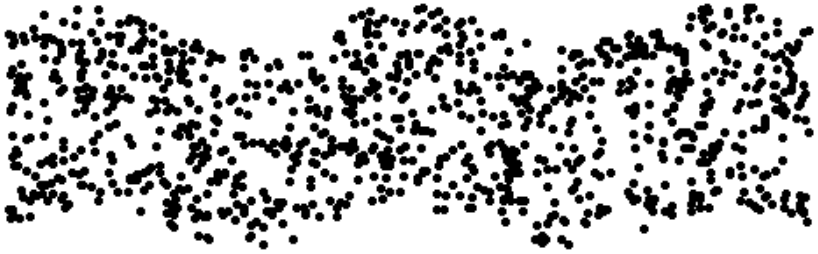
Longitudinal Wave

- **Wave pulse** is a single wave disturbance

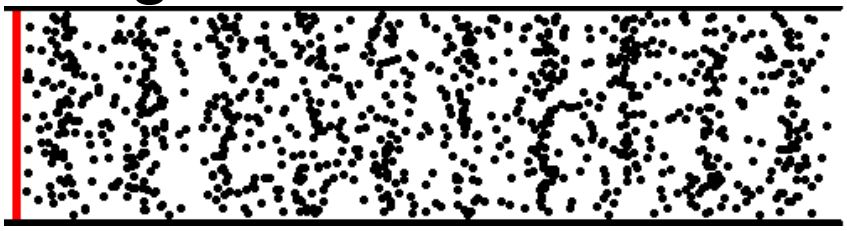
- **Wave train (continuous wave)** - is a series of pulses at intervals

Types of Mechanical Waves

Transverse



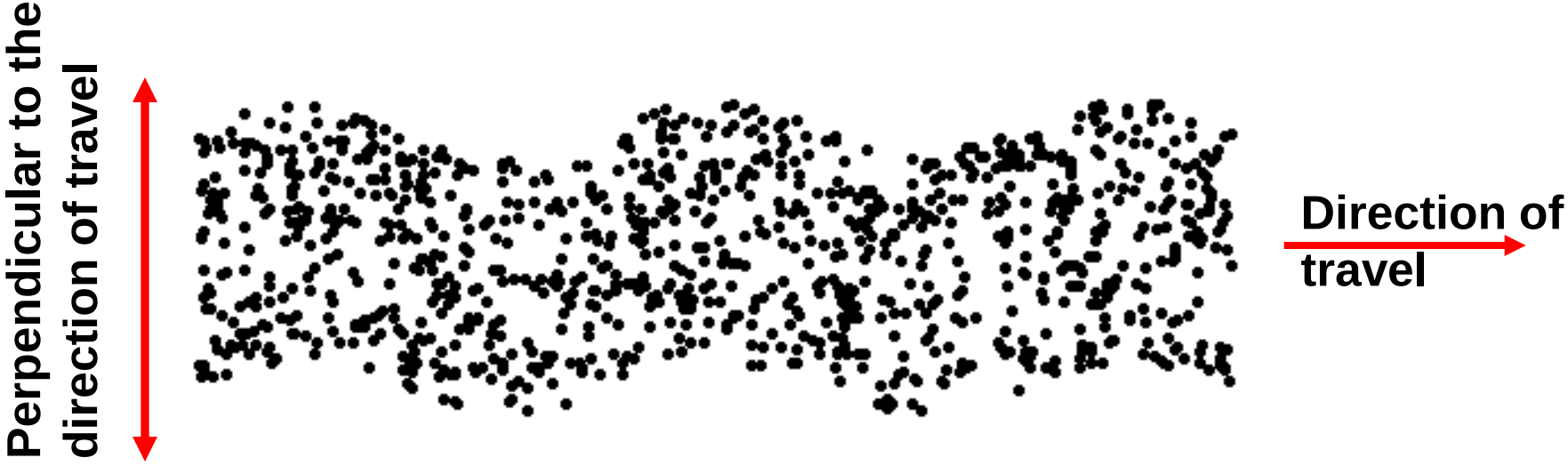
Longitudinal



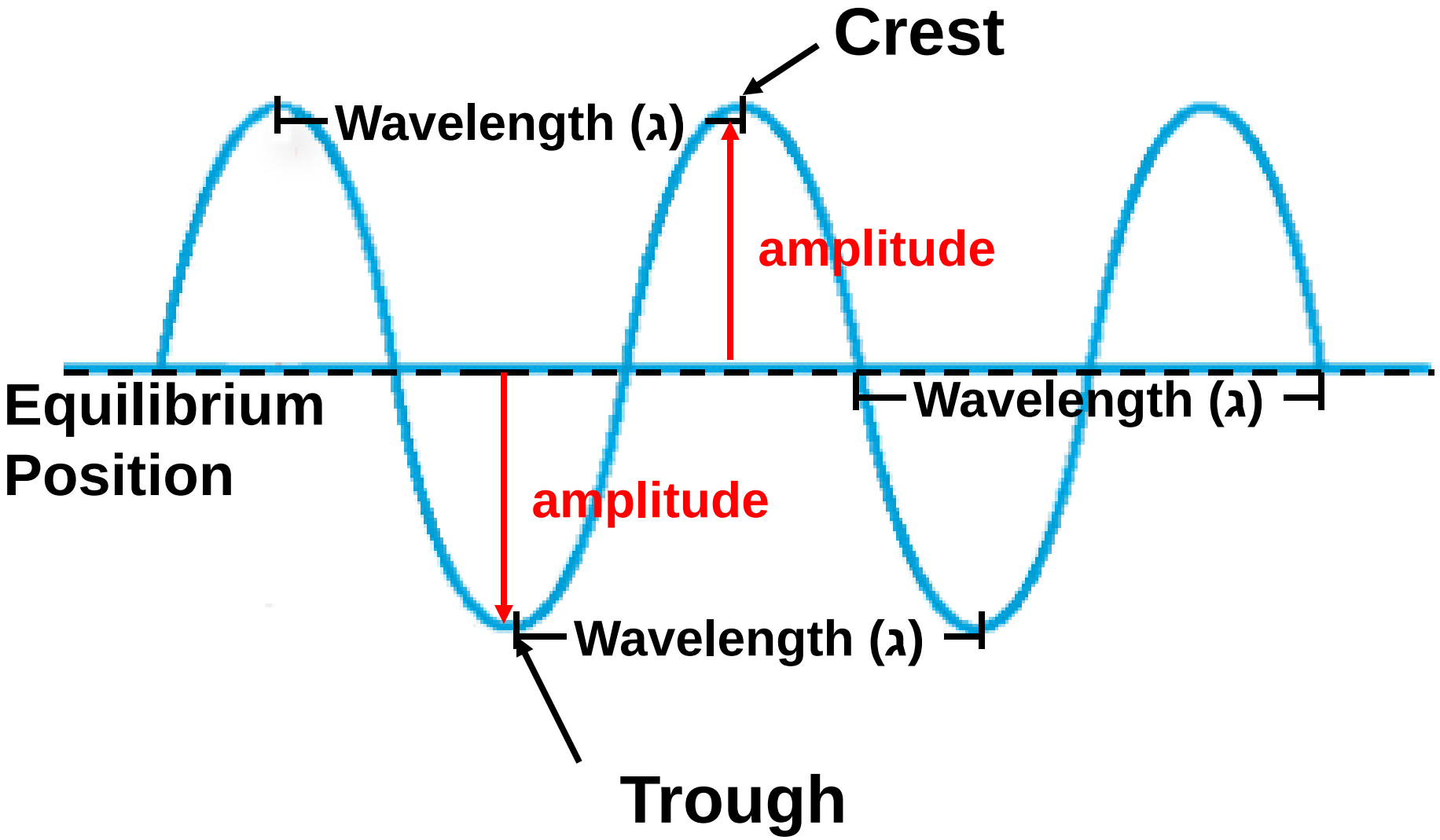
Types of Mechanical Waves

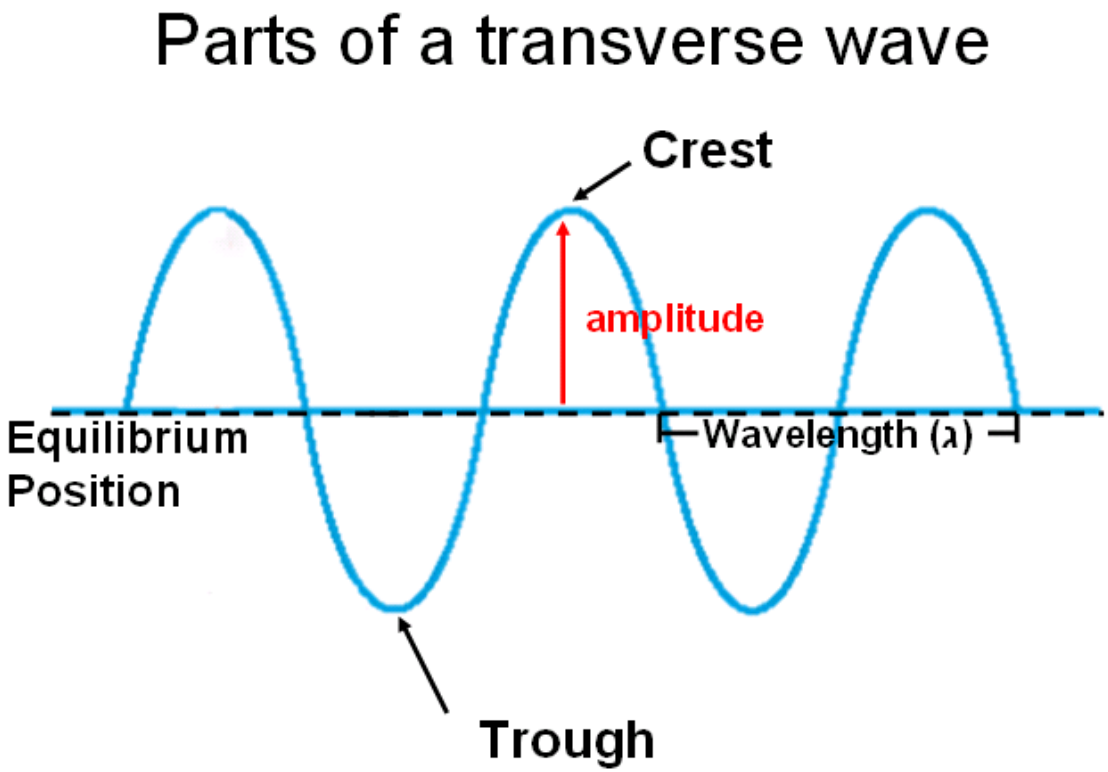
Transverse Wave:

- Wave particles move perpendicular to the direction the wave travels
- Ex. vibrating string of a musical instrument



Parts of a transverse wave



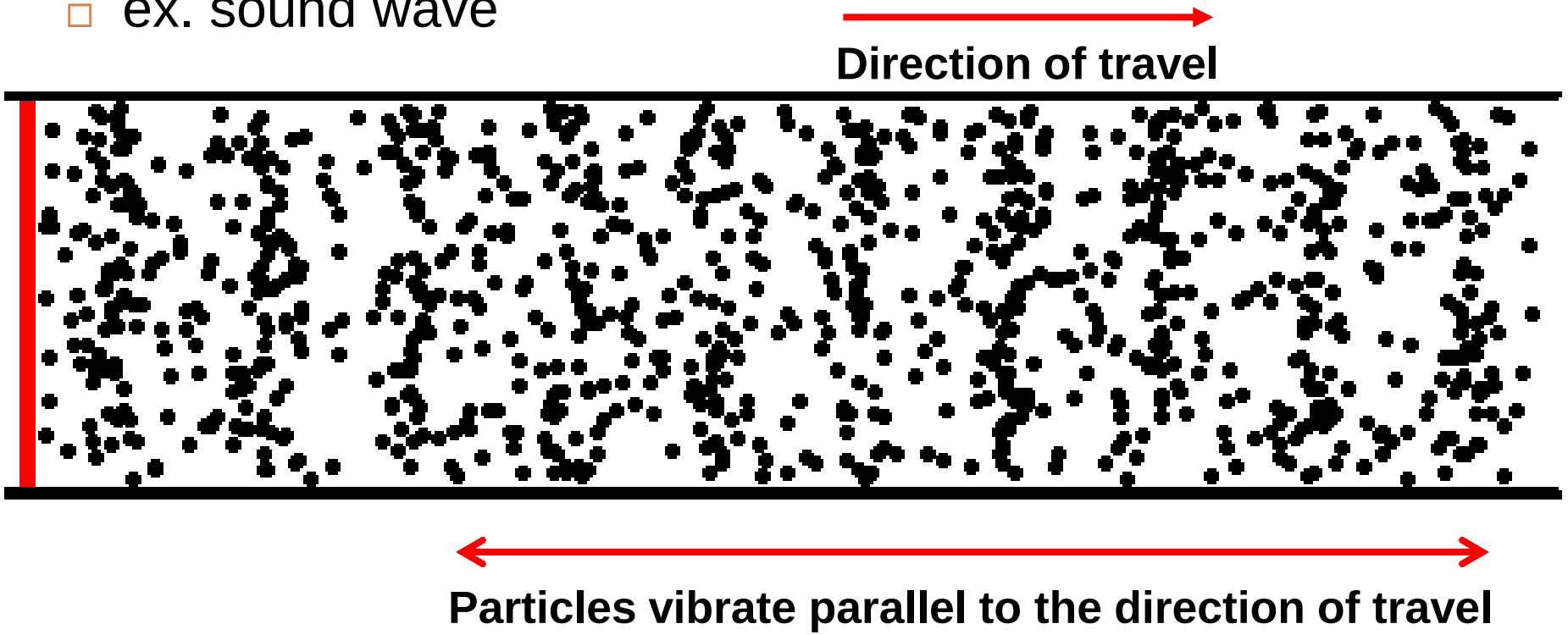


- **Crest**- highest point on a transverse wave
- **Trough**- lowest point on a transverse wave
- **Equilibrium position**- center around which simple harmonic motion occurs
- **Amplitude**- from the equilibrium position to the crest or trough

Types of Mechanical Waves

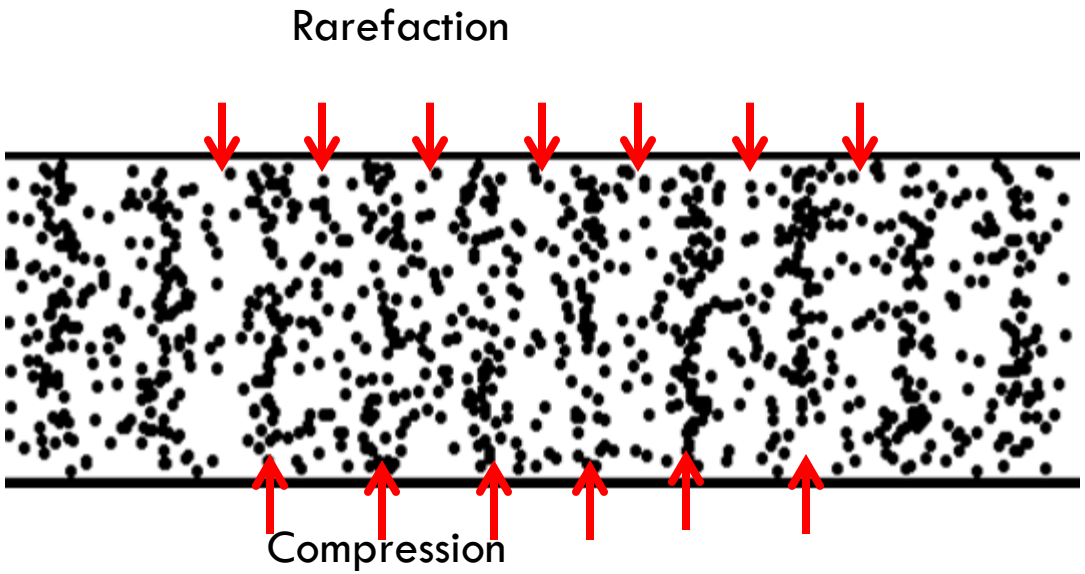
Longitudinal Wave:

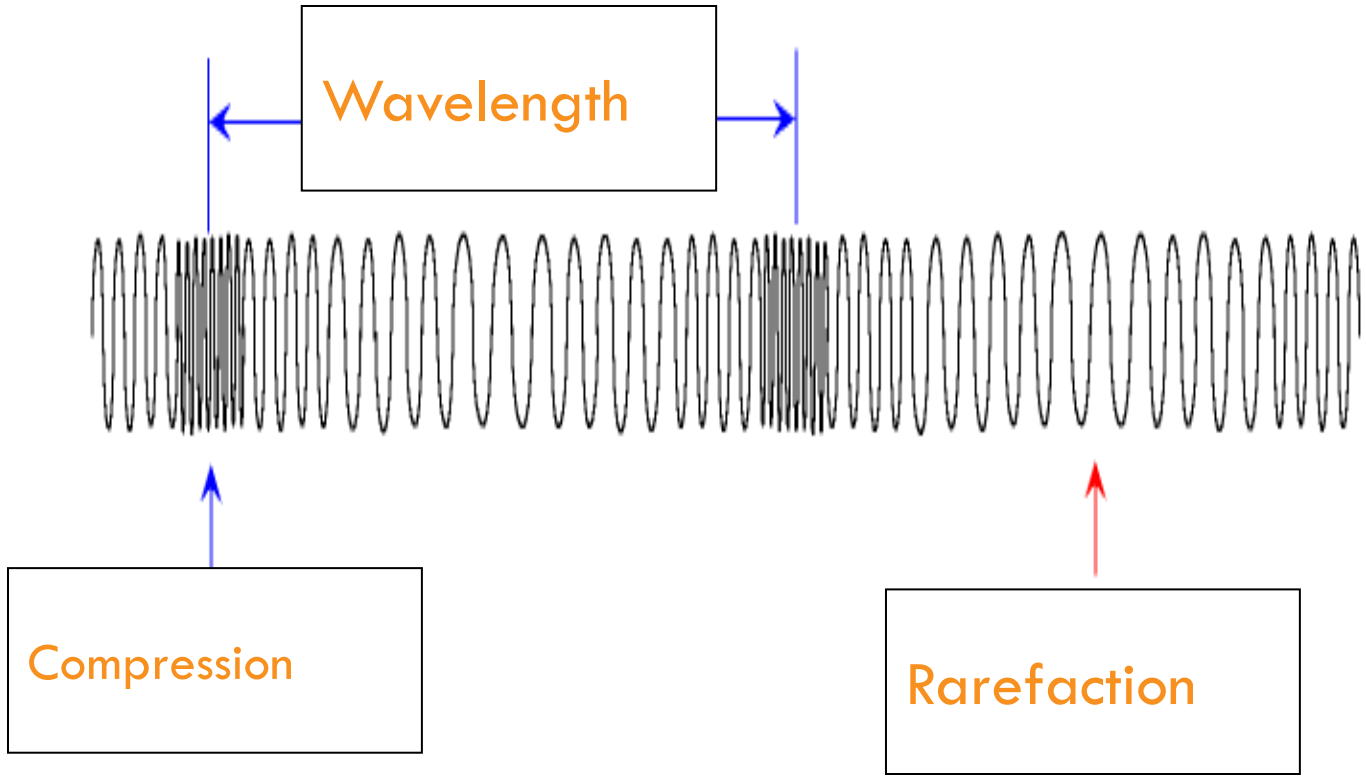
- Particles vibrate parallel to the direction the wave travels
- ex. sound wave



Parts of a Longitudinal Wave:

- **Compression-** point where the particles are closest together
- **Rarefaction-** point where the particles are furthest apart




Wavelength
Compression
Rarefaction

Wavelength, Frequency and Wave Speed

$$v = f\lambda$$

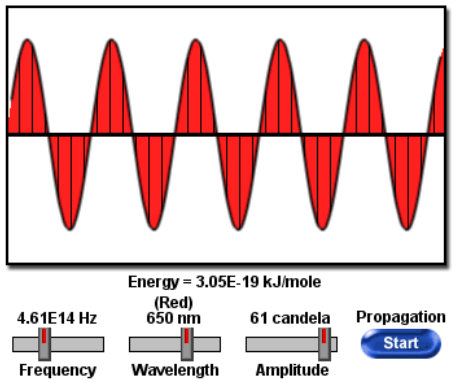
- **velocity** (v): speed of the wave.
  - unit: m/s (meter/second)
- **frequency** (*f*): vibrations per second of the wave
  - unit: Hz (hertz)
- **wavelength** (λ): length of one wave pulse
  - unit: m (meter)

Relationship between frequency and wavelength.

- Wavelength and frequency are inversely related
- As frequency goes up the wavelength gets shorter (assuming no change in velocity)

$$v = \uparrow f\lambda \downarrow$$

Click for animation



Period (T) vs. Frequency (f)

Recall from rotation:

- Period (T) – seconds for one cycle
  - Measured in s
- Frequency (f) – cycles for one second
  - Measured in Hz

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

$$f = \frac{\text{cycles}}{\text{second}}$$

Example 1

The frequency of a wave is 560 Hz. What is its period?

Example 2

- What is the wavelength of a sound wave with a frequency of 50 Hz? (Speed of sound is 342 m/s)
  - How long will it take this wave to travel across a football field (92m)?