Sound Waves

Waves and Energy

- A **wave** is any disturbance that transmits energy through matter or empty space.
- The energy passed along by a wave moves farther and farther from the source of energy.
- Energy can be carried away from its source by a wave. However, the material through which the wave travels does not move with the energy.

Waves and Energy, *continued*

- **Vibrations and Waves** A repetitive, back-and-forth motion of an object is called a **vibration**

- Vibrations set up wave disturbances in a material, and the waves spread away from the source of vibration.

- A vibrating particle passes its energy to a nearby particle. In this way, energy is transmitted through a material.

Waves and Energy, *continued*

- **Energy Transfer Through a Medium** Most waves transfer energy by the vibration of particles in a medium. A **medium** is matter through which a wave can travel.

- These are called "*mechanical waves*."

- Sound waves, water waves, and seismic waves all need a medium through which to travel.

Wave Energy, *continued*

- **Energy Transfer Without a Medium** Visible light waves, microwaves, radio waves, and X rays are examples of waves can transfer energy without going through a medium.

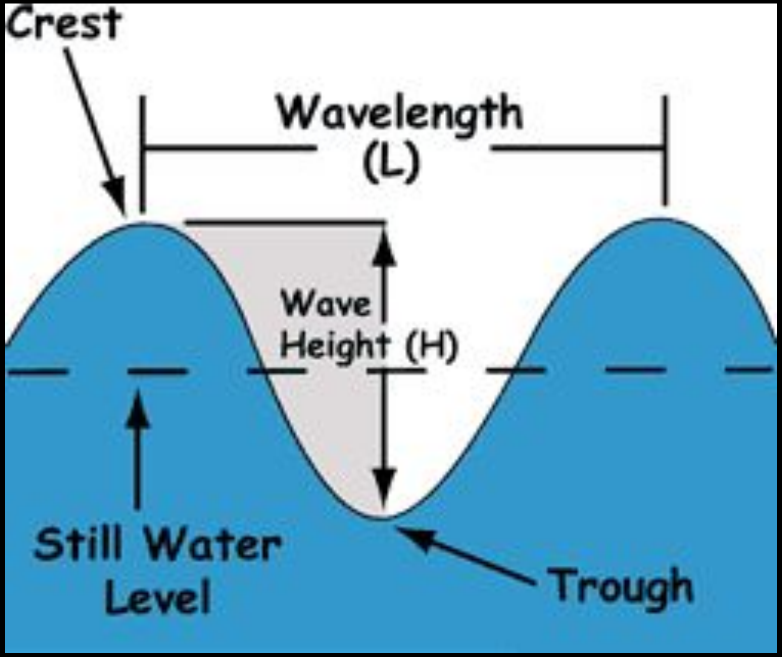
- These waves are *electromagnetic waves*. Although electromagnetic waves do not need a medium, they ***can*** go through matter.

TRANSVERSE WAVES

- **Transverse Waves** are waves in which the particles vibrate perpendicularly to the direction the wave is traveling.
- Transverse waves are made up of *crests* and *troughs*.
- Water waves, waves on a rope, and electromagnetic waves are examples of transverse waves.

Crests and Troughs of Transverse Waves

- Transverse waves have alternating high points and low points.
- The high point of a wave is a crest.
- The low point of a wave is a trough.



LONGITUDINAL WAVES

- **Longitudinal Waves** are waves in which the particles vibrate back and forth along the path that the waves moves.

- longitudinal waves are made up of ***compressions*** and ***rarefactions***.

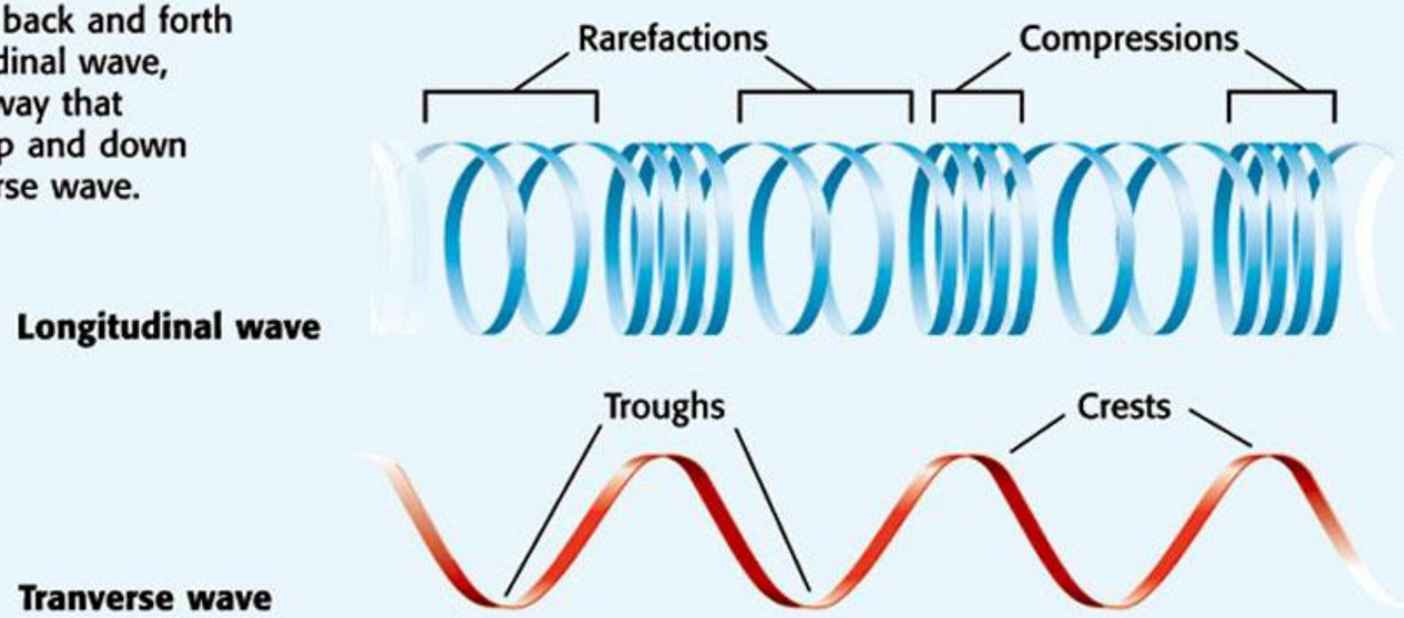
- Waves on a spring are longitudinal waves.

Rarefactions and Compressions of Longitudinal/Compression Waves

- Longitudinal waves ***do not*** have crests and troughs.
- The region where the particles of matter are crowded together as the wave of energy moves through is called a compression.
- The region where the particles are spread out as the wave moves through is called a rarefaction.
- Sound is a longitudinal wave

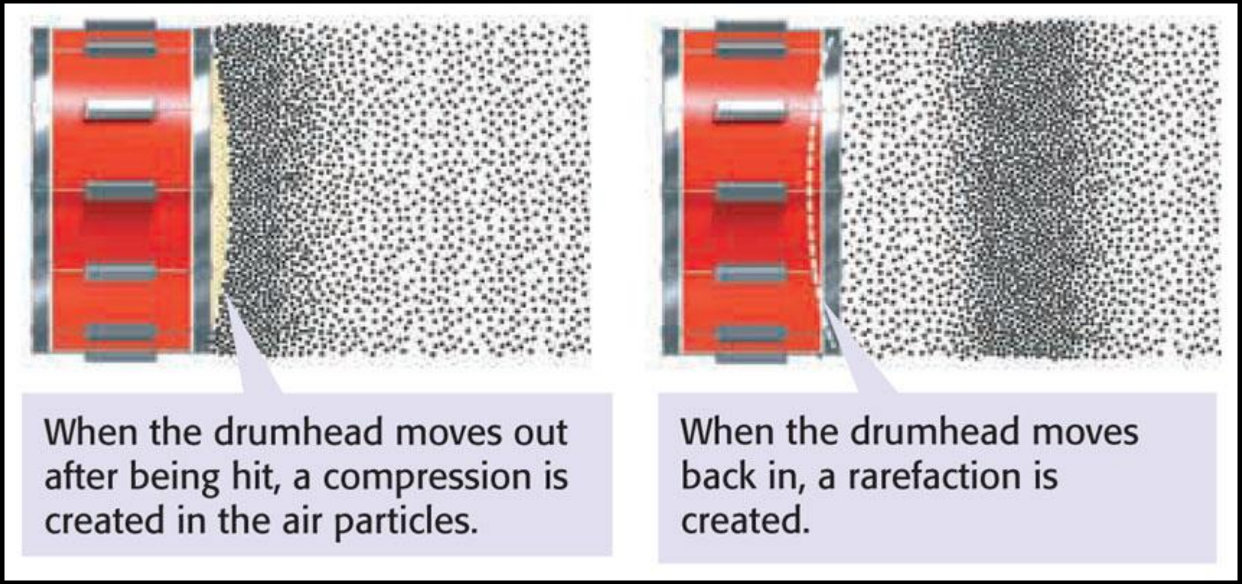
Comparing Longitudinal and Transverse Waves

Pushing a spring back and forth creates a longitudinal wave, much the same way that shaking a rope up and down creates a transverse wave.



SOUND WAVES

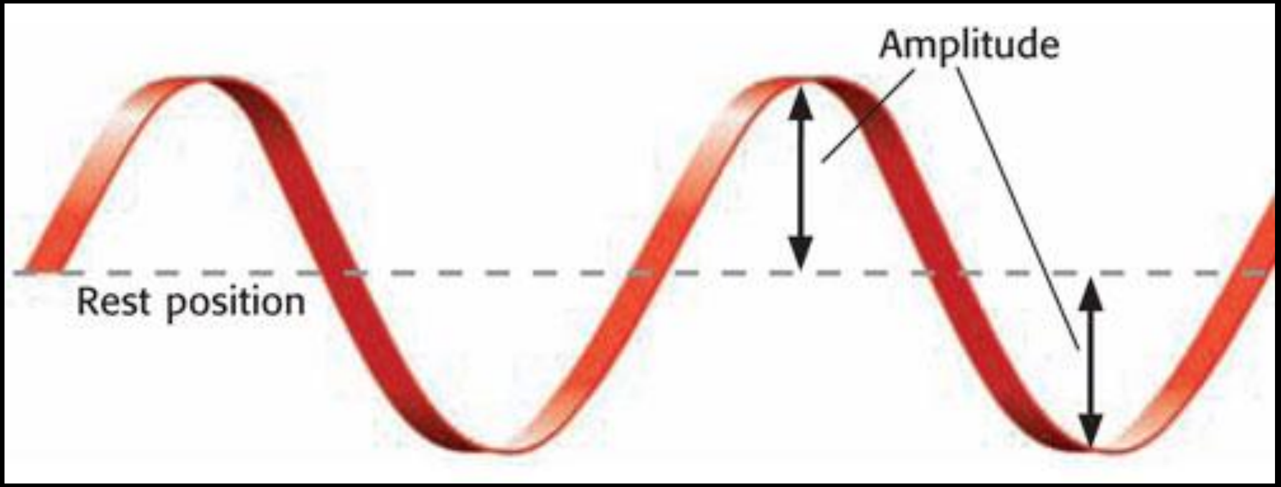
- **Sound Waves** are longitudinal waves. Sound waves travel by compressions and rarefactions of air particles, as shown below.



Amplitude

- The **amplitude** of a wave is the maximum distance that the particles of a medium vibrate from their rest position.

- A wave with a large amplitude carries more energy than a wave with a small amplitude does.



WAVELENGTH

- A **wavelength** is the distance between any point on a wave to an identical point on the next wave.
- A wave with a shorter wavelength carries more energy than a wave with a longer wavelength does.

FREQUENCY

- **Frequency** is the number of waves produced in a given amount of time.
- Frequency can be found by counting the number of crests or troughs that pass a point each second.
- Frequency is usually expressed in *hertz* (Hz). One hertz equals one wave per second.
- *High frequency* means more waves per second.
- *Low frequency means fewer waves per second.*
- If the amplitudes (wave heights) are equal, high-frequency waves carry more energy than low-frequency waves.

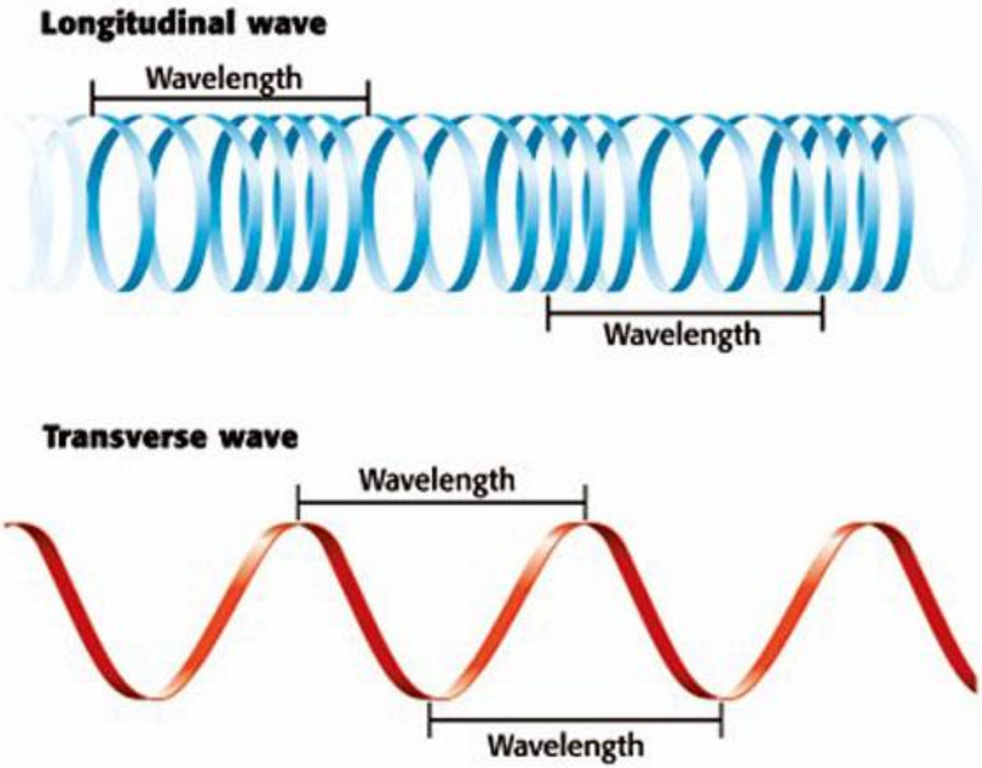
HERTZ

- A frequency of 1 Hz means that 1 wavelength passes a point in one second. 5 Hz means that 5 waves pass a point in one second.

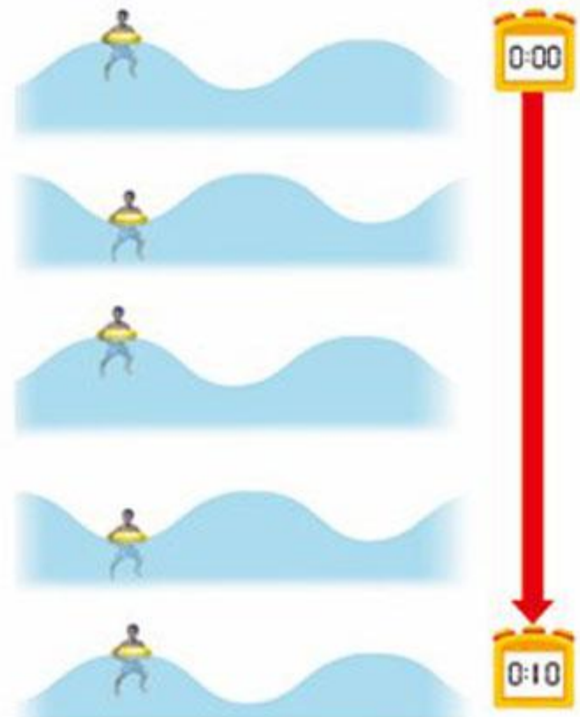
- As frequency increases, wavelength decreases. In other words, the more waves that go by per second, the distance between them decreases.

Measuring Wavelengths

Wavelength can be measured from any two corresponding points that are adjacent on a wave.



Measuring Frequency



Frequency can be measured by counting how many waves pass by in a certain amount of time. Here, two waves went by in 10 s, so the frequency is 2/10 s = 0.2 Hz.

WAVE SPEED

- **Wave Speed** is the speed at which a wave travels.
- The speed depends on the medium a wave travels through.
- Waves usually travel faster in liquids and solids than they do in gases.
- An exception is light waves, which travel through empty space fastest, and gases next fastest.
- Sounds waves travel faster in a medium if the temperature is increased.

WAVE VELOCITY

- Wave Velocity(*v*) can be calculated using wavelength (λ) and frequency (*n)*, by using the wave equation, which is shown below:

$v = \lambda \times n$ *speed = frequency x wavelength)*

WAVE Period

- The amount of *time* it takes for one wavelength to pass a point is the wave's **period**.

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More on Compressional Waves