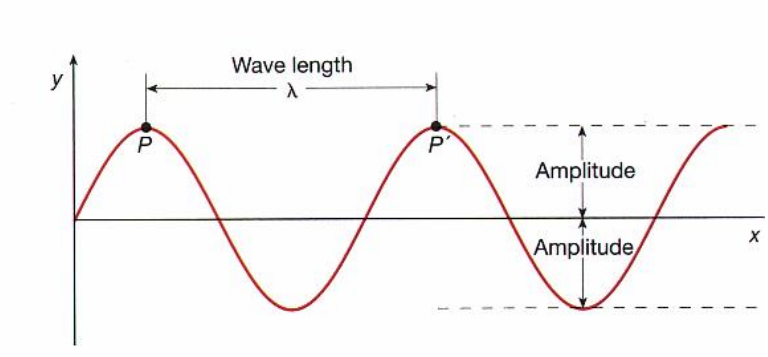
WAVES

Concept of Wave

- A ***wave*** is a ***disturbance*** that is ***propagated*** through a system. Waves transfer energy.

- ***Crest:*** the highest point on a wave.
- ***Trough:*** the lowest point on a wave.
- ***Amplitude:*** the ***maximum displacement*** in a wave; the height of a crest or depth of a trough. It is related to the ***energy*** of a wave.



- ***Wavelength (λ):*** the distance between any 2 succesive crests or troughs.
  Units = m or cm.
- ***Frequency (f):*** the number of waves produced per unit time.
  Units = waves/s or Hz
- ***Period (T):*** the number of seconds per unit wave

$$T = \frac{1}{f} \quad \text{and} \quad f = \frac{1}{T}$$

WAVE SPEED

- The speed of a wave can be calculated from its frequency and wavelength.

$$\frac{\cancel{\text{waves}}}{\text{second}} \times \frac{\text{meters}}{\cancel{\text{wave}}} = \frac{\text{meters}}{\text{second}}$$

$$f \times \lambda = s$$

Examples:

1. A sound wave has a speed of 344 m/s and a wavelength of 0.5 m. What is the frequency of this wave?

   f =

   λ =

   s =

2. A sound wave has a speed of 344 m/s and a frequency of 20 kHz. What is the wavelength of this wave?

   f =

   λ =

   s =

3. An ocean wave passes a point on the pier at the rate of 12 waves per minute. What are the frequency and period of this wave?

   # of waves =

   Time =

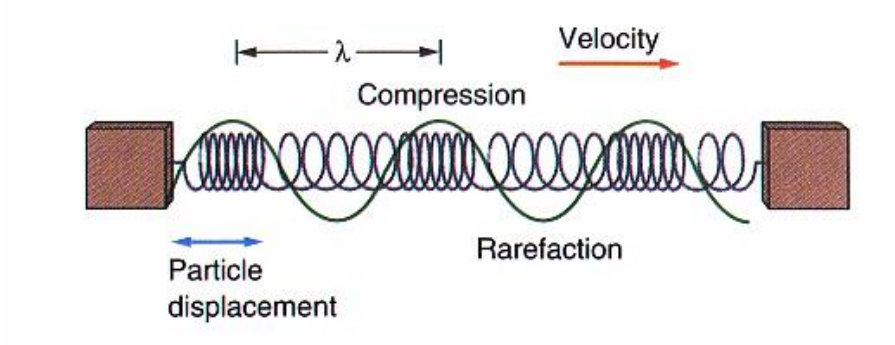
   f =

   T =

WAVES TYPES

Longitudinal Waves

- Waves in which the direction of particle ***movement*** is ***parallel*** to the direction of ***wave velocity***, are called ***longitudinal*** waves.

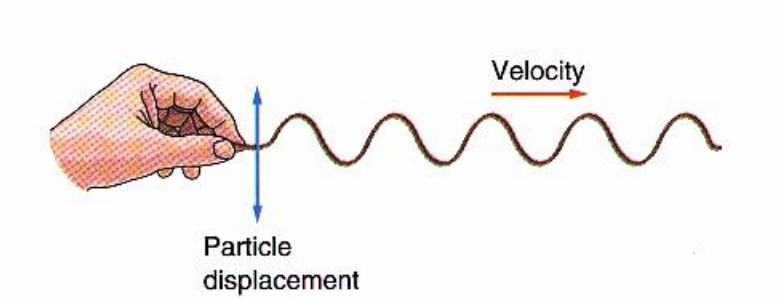


- Longitudinal waves are composed of areas of ***high*** particle ***density*** (***compressions***) and areas of ***low*** particle ***density*** (***rarefactions***).

- ***Sound*** is the most common example of a ***longitudinal wave***.

Transverse Waves

- Waves in which the direction of particle ***movement*** is ***perpendicular*** to the direction of ***wave velocity***, are called ***transverse*** waves.



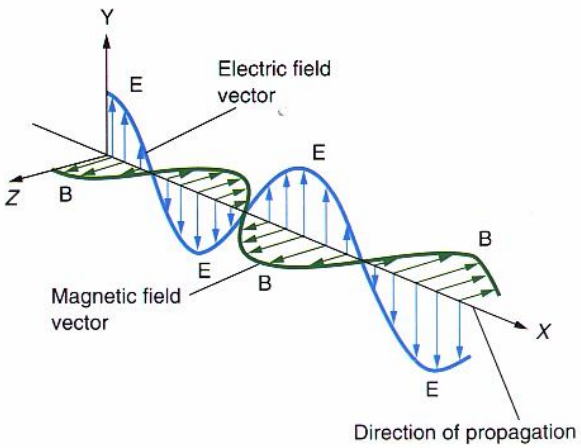
- Two examples of transverse waves are ***mechanical*** waves and ***electromagnetic*** waves (light, microwave, x-rays, etc.)

ELECTROMAGNETIC WAVES

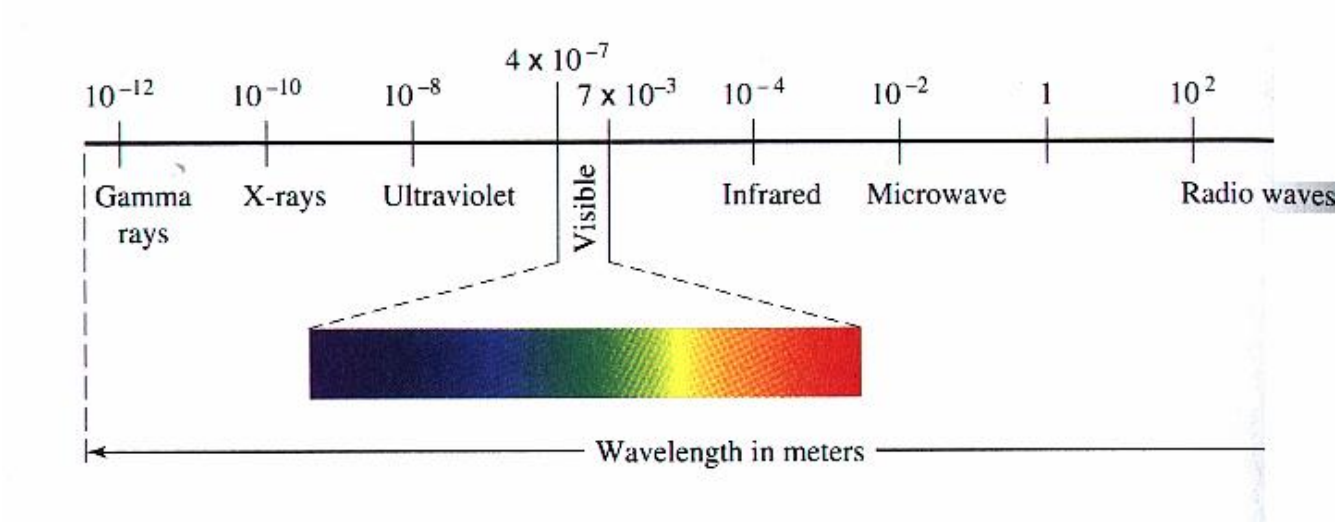
- ***Electromagnetic*** waves are ***transverse*** waves caused by ***vibrating electrons***.

- They are formed through interaction of ***electric and magnetic fields*** that are ***perpendicular*** to one another.

- In ***vacuum***, all electromagnetic waves travel at the ***same speed*** and ***differ*** from each other in their ***frequency***.



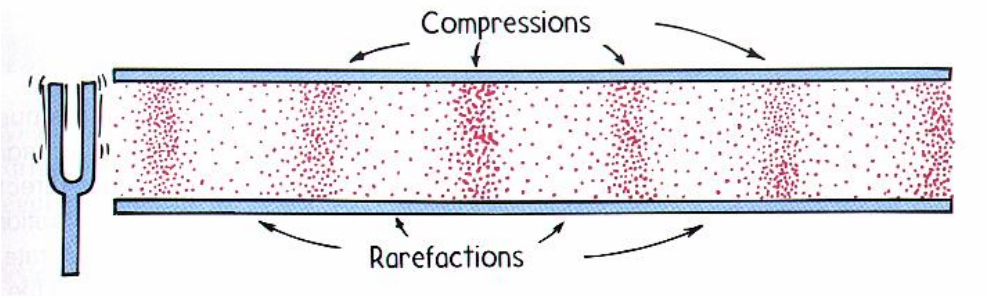
- The ***classification*** of electromagnetic waves according to their frequency is called ***electromagnetic spectrum***. These waves range from ***gamma rays*** (shortλ, high f) to ***radio waves*** (long λ, low f).



SOUND WAVES

- ***Sound*** is the most common example of a ***longitudinal wave***.

- When sound waves are produced, the ***molecules of air*** transmit the vibrations through ***compressions and rarefactions***.



- Sound, as all ***longitudinal waves***, ***cannot*** travel in ***vacuum***.

Velocity of Sound

- ***Velocity*** of sound is ***affected*** by wind conditions, ***temperature***, ***humidity*** and ***type of medium***.

- It is ***not affected*** by ***loundness*** of sound (***amplitude***).

- Sound travels ***faster*** in ***liquids and solids*** compared to ***gases***. ***Closer packing*** of solid and liquid ***molecules*** transmit the vibrations faster than gases.

- Sound travels ***faster at higher temperature***. ***Faster moving*** air particles ***bump*** into each other more ***frequently*** and carry vibrations in shorter time.

DOPPLER EFFECT

Doppler Effect

- ***Pitch*** of a sound is the subjective measure of its ***frequency***. High frequency sounds have ***high pitch***, and low frequency sounds have ***low pitch***.

- The apparent ***shift*** in ***pitch*** of a sound when its ***source is moving relative to the observer*** is called the ***Doppler*** effect.

The pitch of sound increases when the source moves toward you and decreases when the source moves away.

- The sudden ***change in pitch*** of an ambulance siren as it goes by is the result of the ***Doppler effect***.

STANDING WAVES / RESONANCE

Standing Waves

- Waves that are ***reflected on themselves*** and appear to "stand" are called standing waves.

- Standing waves are used to produce the variety of sounds in musical instruments.

Resonance

- Every object has ***natural vibrations*** caused by motion of its molecules.

- When a ***forced vibration matches*** an objects's ***natural vibrations***, a dramatic ***increase in amplitude*** occurs. This phenomena is called ***resonance***.

Is it Live or is it Memorex?
The famous commercial claims that the ***resonance*** caused by the singer's ***voice*** and the ***natural frequency of glass*** causes it to break.