Physics **Name**_____

Unit 1 – Wave Motion Notes **Date** _____ **Block**___

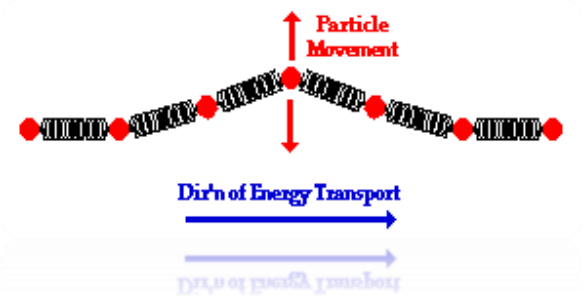
What is a Wave?

- A disturbance that transfers _____, not _____ through space.

- **Pulse** – A _____ disturbance moving through a medium.

- **Medium** – A substance or material which carries a wave.

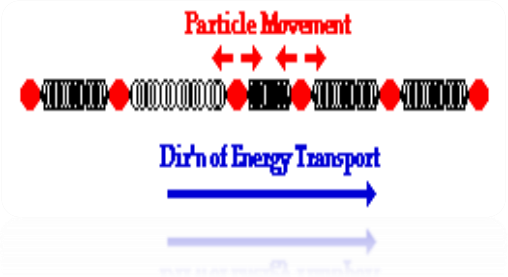
- **Wave –** A _____ disturbance moving through a medium.



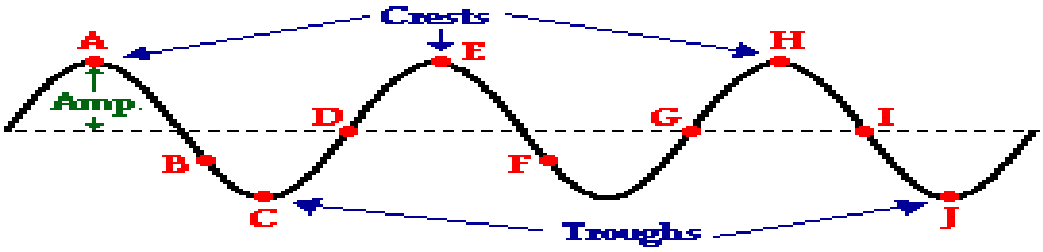
Types of Waves

- **Transverse** – A wave that occurs when the medium moves or vibrates _____ to the direction of the wave motion.

- **Longitudinal –** A wave that occurs when the medium moves or vibrates _____ to the direction of the wave motion.



Anatomy of a Wave (Transverse)



- **Dashed Line** – the rest position, *no disturbances.*
- **Crest –** maximum _____ peak.
- **Trough –** maximum _____ peak.
- **Amplitude -** _____ of the wave or the amount of _____ a wave carries.
- **Wavelength –** The distance between 2 successive points in phase.
  - Crest to crest
  - Trough to trough
  - One crest and one trough

Math Vocabulary & Equations

- **Frequency –** The number of complete vibrational cycles of a medium per a given amount of time; *the number of crests that pass per second*.
    - **Symbol**: f
    - **Units:** waves/second, Hertz (Hz)
    - **Equation:**
        - *If period is unknown:* Count the number of crests that pass and divide by time.
        - *If period is known:* f = 1/T

- **Period –** The time for a particle on a medium to make one complete vibrational cycle; *the time for the wave to go from crest back to crest.*
    - **Symbol**: T
    - **Units:** second (s)
    - **Equation:**
        - *If frequency is unknown:* Identify the time it takes for one cycle of the wave in seconds.
        - *If frequency is known:* T = 1/f

- **Speed –** Answers the question of _____ the wave moves. Must know a _____ traveled in meters and length of _____ in seconds.
    - **Symbol**: s
    - **Units:** meters/seconds (m/s)
    - **Equation:** s = d/t
    - **Example 1**
        - A marine weather station detects waves that travel a distance of 50.0 meters in 21.8 seconds. Determine the speed of these waves.

    - **Example 2**
        - Tsunamis are much different than rogue waves. While rogue waves and other waves are generated by winds, tsunamis originate from geological events such as movements of tectonic plates. Tsunamis tend to travel very fast. A tsunami generated off the coast of Chile in 1990 is estimated to have traveled approximately 6200 miles to Hawaii in 15 hours. Determine the speed in mi/hr and m/s. (1 km = 0.62 miles)

- **Wave Equation –** Used to solve for the speed of a wave if the wavelength and frequency of a wave are known.
    - **Symbol**: s
    - **Units:** meters/seconds (m/s)
    - **Equation:** $s = \lambda f$
    - **Relationship:** Wavelength is _____ proportional to frequency.
    - **Example 1**
        - A sound wave has a frequency of 262 Hz and a wavelength measured at 1.29 m.
            a) What is the speed of the wave?

            b) How long will it take to travel the length of a 91.4-m football field.

            c) What is the period of the wave?

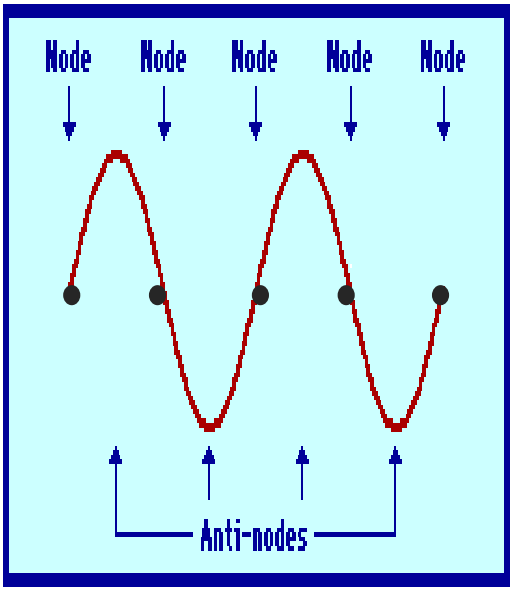
Factors Affecting Wave Speed

- The speed of a wave _____ depend on the _____ of the wave.
- The speed of a wave _____ depend on the _____ through which the wave is moving.
- The speed of the wave is not affected by a change in _____ as long as the medium remains the same.

Speed of a Wave				
Trial	Tension (N)	Frequency (Hz)	Wavelength (m)	Speed (m/s)
1	2.0	4.05	4.00	16.2
2	2.0	8.03	2.00	16.1
3	2.0	12.30	1.33	16.4
4	2.0	16.2	1.00	16.2
5	2.0	20.2	0.800	16.2
6	5.0	12.8	2.00	25.6
7	5.0	19.3	1.33	25.7
8	5.0	25.5	1.00	25.5

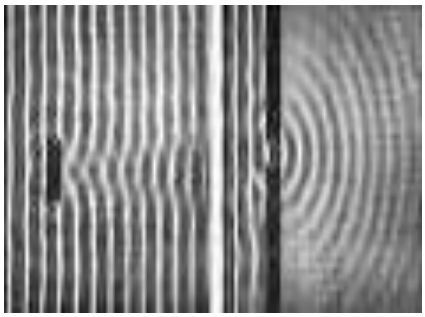
Standing Waves

- A _____ that results when a wave is _____ to a given space in a medium.
  - The wave pattern is *only produced* when one end of the rope is *vibrated at just the right frequency*.



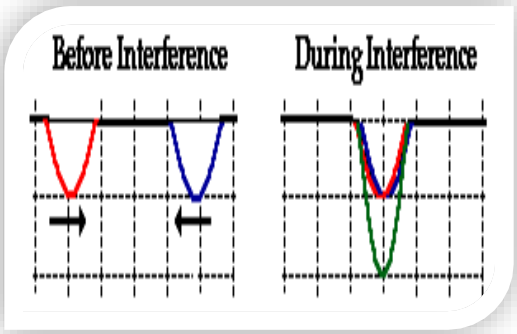
- **Nodes** – areas of _____.
  - destructive interference
- **Antinodes** – areas of _____.
  - constructive interference

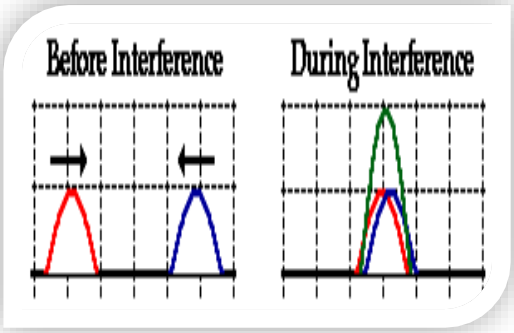
Wave Behaviors



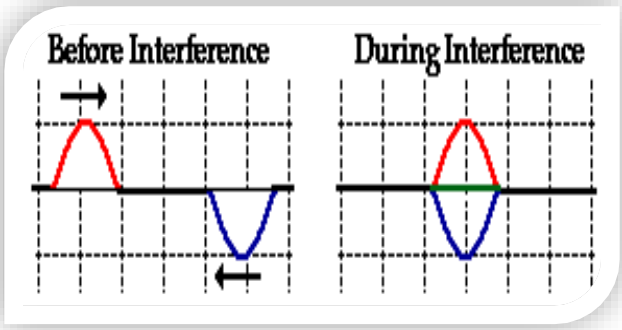
- **Diffraction –** Involves a change in direction of waves as they pass through an _____ or around a _____ in their path.

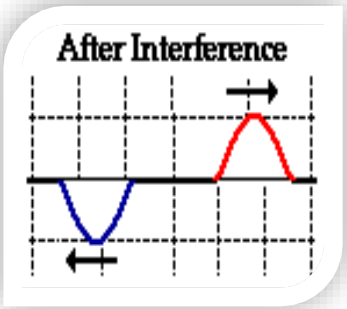
- **Interference** – When two waves interfere, they _____ to form a _____ wave. The waves continue to _____ through one another after interference. This is also known as the **principal of superposition**.
    - **Constructive Interference –** Occurs when interfering waves have displacements in the _____ direction
        - **Amplitudes** _____.



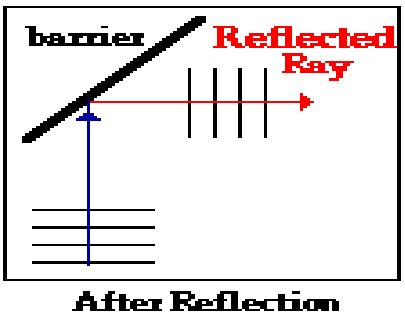


    - **Destructive Interference –** Occurs when interfering waves have displacements in the _____ direction.
        - **Amplitudes** _____.

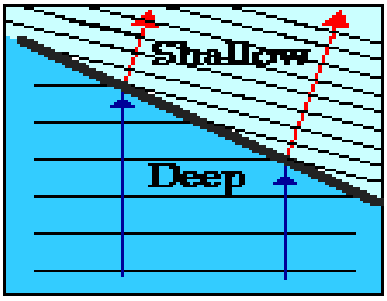




- **Reflection –** When waves reach a barrier they bounce off and head in a different direction. The _____ at which the waves approach the barrier will always _____ the angle at which they reflect off the barrier.



- **Refraction –** Involves a change in direction of the waves as they pass from one _____ to another (due to a change in speed).



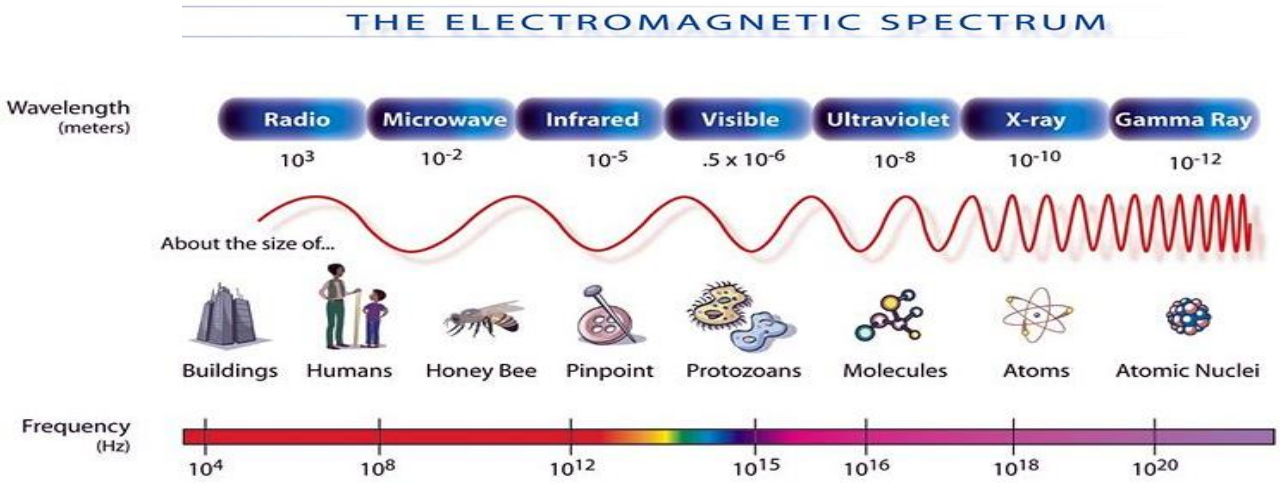
The Nature of Light Waves

- **Sources of Light**
  - _____ – A source of light; a body that emits its own light waves.
  - _____ – Reflects light waves.

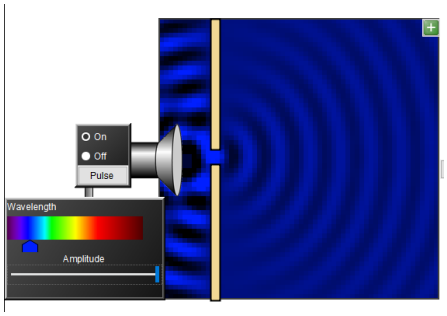
- Before the 17th century people thought light was instant.

- Early experiments showed light had a finite speed (Roemer).
  - The generally accepted value is **3.0×10^8 m/s** (186,000 miles/second)

- Light is an _____, a wave produced by a vibrating electric charge.
  - *Light can be thought of as a wave or as a particle!*
  - Electromagnetic waves are capable of transporting energy though the vacuum of outer space.
  - Electromagnetic waves are listed on the spectrum by varying frequencies & wavelengths.

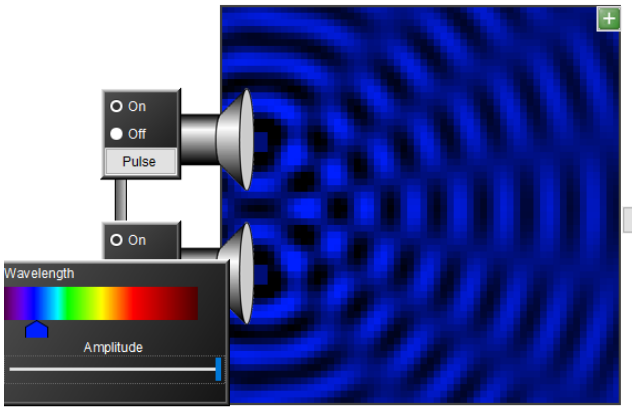


Wave Behaviors & Light Waves



- **Diffraction** – Occurs when light bends around a barrier while traveling in the same medium.
    - ***Example:*** *Seeing light come from down the hall of another room in your house.*

- **Constructive Interference –** Occurs when either 2 _____ or 2 _____ meet in the same medium.
    - A bright spot or band is the result.



- **Destructive Interference –** Occurs when _____ meet _____ in the same medium.
    - A dark spot or band ("fuzz" in simulations) is the result.

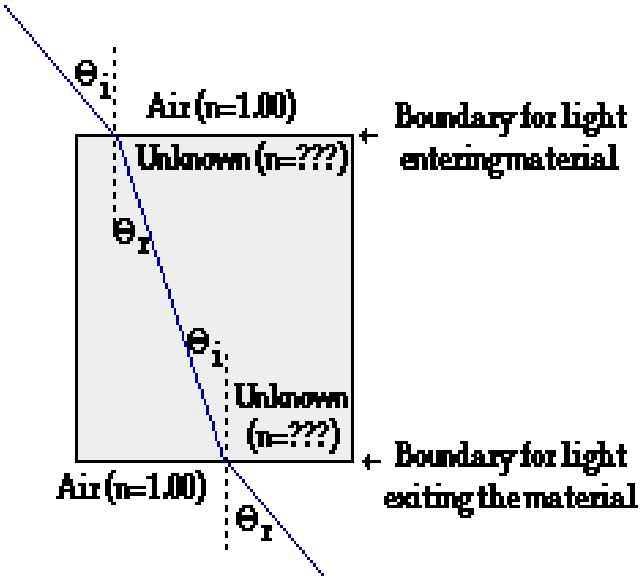
- **Reflection –** Occurs when light bounces off a barrier.
    - The _____ always bounces off the barrier at an _____ angle to the _____.

    - ***Reflection in a Plane Mirror Lab***
        - Produces _____ images.
        - Images are _____.
        - Images are the _____ as the object.
        - The _____ behind the mirror _____ the _____ in front of the mirror.
        - Produces _____ images (formed in areas where light does not actually reach).

- **Refraction –** Occurs when light enters a new medium and changes direction due to a change of speed upon entering the new medium.

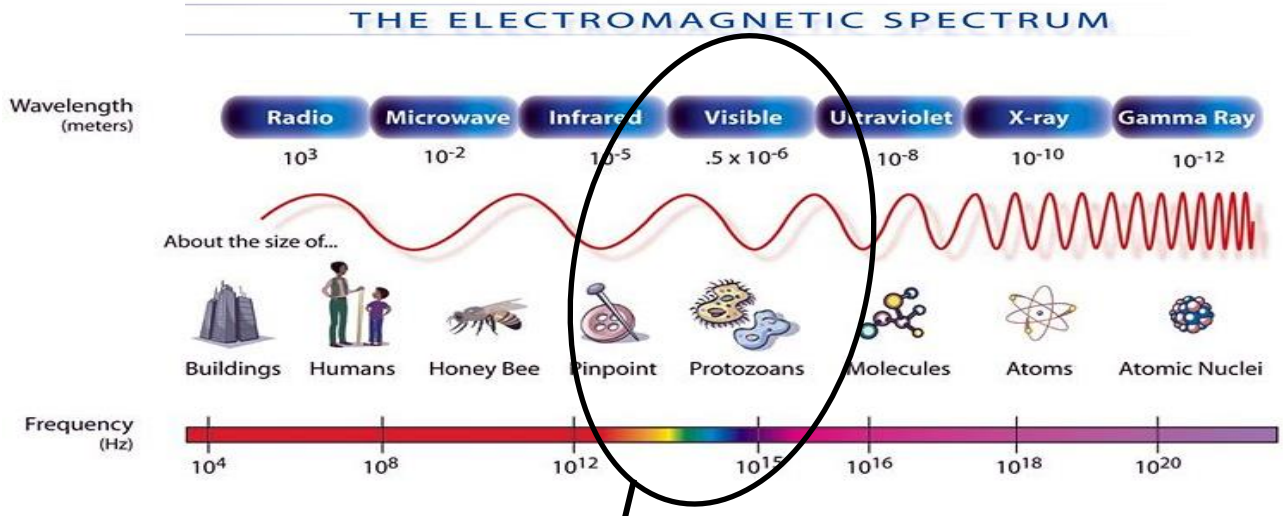
    - The tendency of a ray of light to bend one direction or another is dependent upon whether the light wave _____ or _____ upon crossing the boundary.
        - This change of speed is the result of the ***optical density*** of the material.
        - ***Index of Refraction*** is a numerical value that relates the speed of light in a vacuum to the speed of light in the material.

- ***Refraction in a Glass Plate Lab***
  - If light travels from a _____ medium to a _____ medium (i.e. air to glass), then the light ray will bend _____ the normal.



  - If light travels from a _____ medium to a _____ medium (i.e. glass to air),then the light ray will bend _____ from the normal.

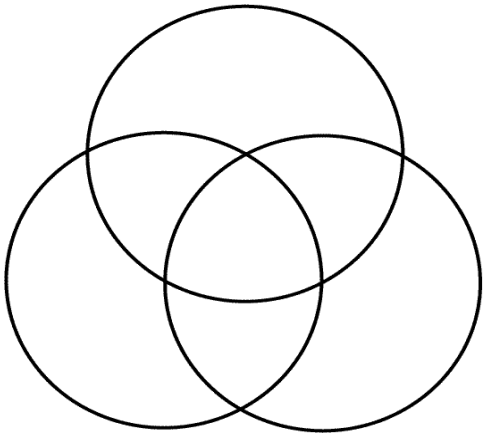
Electromagnetic Spectrum & Visible Light



- Exists as a narrow band of frequencies that our eyes can detect.
- When light of a _____ strikes the retina of our eye, we perceive that specific color.

Light & Color Addition

- When you look at an object the color you see is associated with a certain _____(s).
- The _____ together (or _____) of two or three of the three primary colors of light with varying degrees of intensity can produce a wide range of other colors.

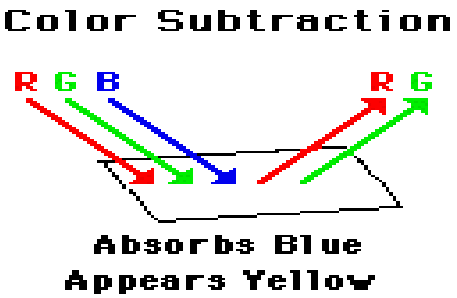


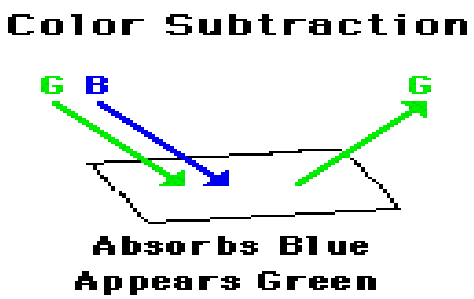
- **Primary Colors –**
- **Secondary Colors –**
- **Complimentary Colors –**

Light & Color Subtraction

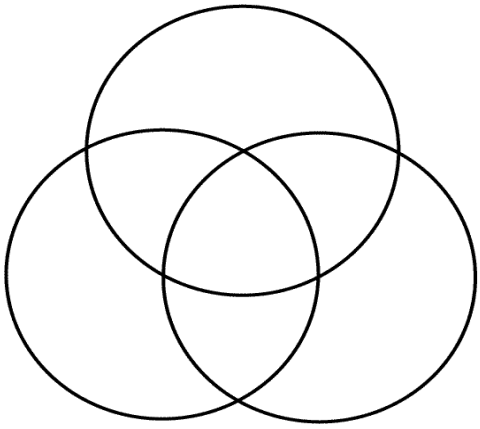
- _____ are materials added to substances such as clothing, paints, paper, etc. that will _____ specific frequencies of light in order to produce a desired appearance.
    - **REMEMBER…**what ***you see*** is the ***reflection*** of that wavelength/frequency, every other color is **absorbed!**

- The color appearance of an object is determined by beginning with a single color or mixture of colors and identifying which color or colors of light are _____ from the original set.
    - **Examples**





- **Primary Pigments –**
- **Secondary Pigments –**
- **Complimentary Colors –**



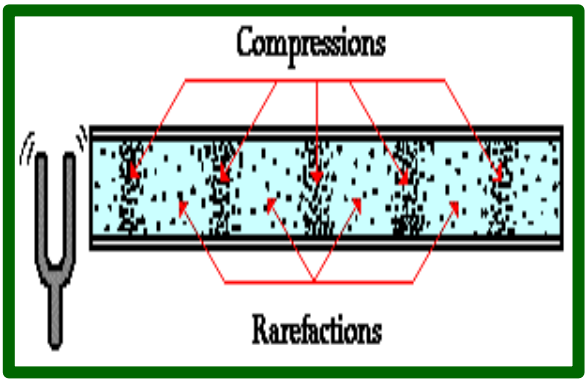
The Nature of Sound Waves

- Sound waves are created by a _____ source that creates disturbances in surrounding _____.

- Sound needs a _____ to travel from one location to another, thus making sound a type of _____ wave.

- Sound waves fall under the category of _____.

- As a sound wave travels, air particles can become compressed or open.
  - _____ - regions where the air particles are compressed together.
  - _____ - regions were the air particles are spread apart.



Sound Properties

- _____ – the sensation of frequencies.
  - High pitch =
  - Low pitch =

- _____ – the amount of energy transported.
  - Large amplitude =
  - Small amplitude =

Speed of Sound

- Use the same formulas for other waves.
- **Example 1 –** A tuning fork produces a sound wave in air with a frequency of 261.6 Hz. At room temperature the speed of sound is 343 m/s. What is the wavelength?

- **Factors Affecting Wave Speed**
  - Properties of the _____.
  - Materials they move through.

Wave Behaviors & Sound Waves

- **Constructive Interference –** Occurs when either 2 _____ or 2 _____ meet.
    - The loud sound produced can be heard is the result of an _____.

- **Destructive Interference –** Occurs when _____ meet _____.
    - Continuous canceling will result in no sound being hear and this is the result of a _____.

- **Diffraction** – Occurs when sound bends around a barrier.
    - ***Example:*** *Hearing sound coming from down the hall.*

- **Reflection –** Occurs when sounds bounces off a barrier.
    - ***Examples:*** *Hearing an echo, Animals using echolocation.*

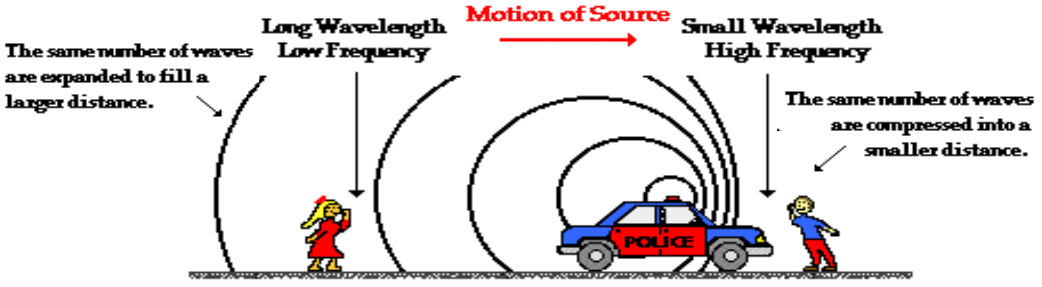
- **Refraction**
    - ***Example:*** *Sound amplification on a cool night due to air density.*

Doppler Effect (Behavior of Light & Sound Waves)

- Occurs whenever the source of waves is _____ with respect to an observer.

- There is an ***apparent*** _____ shift for observers who the source is moving toward.
    - Higher frequency = higher pitch.

- There is an ***apparent*** _____ shift for observers who the source is moving away from.
    - Lower frequency = lower pitch.



Resonance (Behavior of Sound Waves)

- Occurs when one object is vibrating at the _____ natural frequency of a second object and forces the second object into _____.

- The result of resonance is a _____ sound.