Notes for Waves

I. Ask questions to compare and contrast the characteristics of electromagnetic and mechanical waves.

WAVES CARRY ENERGY

Mechanical Waves:
Examples: Ocean, Sound, etc.
Made by vibrating matter (medium).
Travel faster in a thicker medium.

requires a medium

Electromagnetic Waves:
Examples: Light, T.V. broadcasts, cell phone transmissions, etc.
Do not require matter (medium) to travel through.
Travel faster in a thinner medium like space (vacuum).

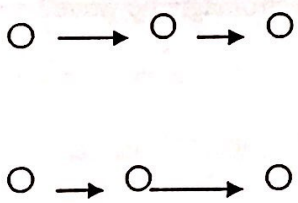
does not require a medium → all are transverse waves

1. longitudinal/compressional - particles move parallel to the wave
2. transverse - particles move perpendicular to the wave

II. Analyze and interpret data to explain how different media affect the speed of sound and light waves.

Speed (v) is dependent on the medium (material it is traveling through).

Mechanical wave speeds: Sound travels faster in solids than in air.

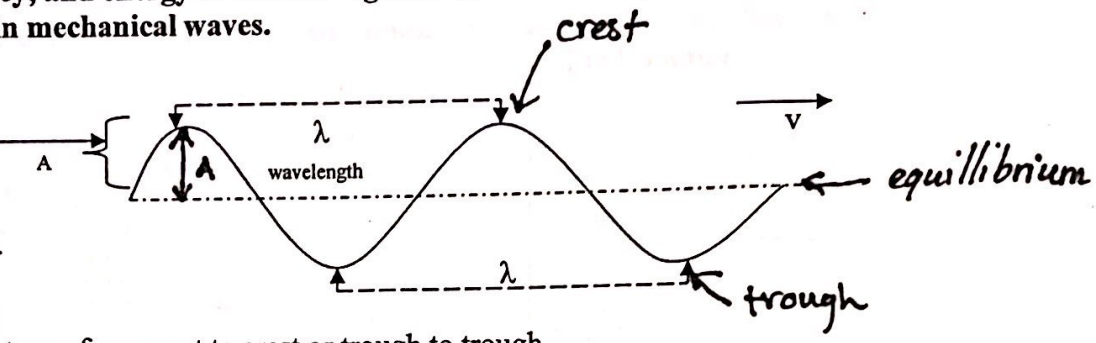
Air	Solid
	 Shorter distance for the particles to travel in solids between bumps.

Electromagnetic wave speeds:

Vacuum: 3×10^8 m/s (speed of light)
Air: almost the same speed
Thicker medium: slower speed for the E.M. waves.
(Example: light in diamonds travel ½ the speed as in air)

↑amplitude ↑Energy

III. Analyze and interpret data to identify the relationships among wavelength, frequency, and energy in electromagnetic waves and amplitude and energy in mechanical waves.



Amplitude: How high the wave gets from the resting position.

= how much energy a wave carries

Wavelength (λ): distance from crest to crest or trough to trough.

Frequency: how often a pulse occurs per second (Hz, hertz)

Frequency and wavelength are inversely proportional. (As one goes up, the other goes down.)

↑λ ↓f
↓λ ↑f

How is energy transferred in:

Mechanical Waves? (Waves requiring a medium) Answer: Amplitude ↑ amplitude ↑ energy

Electromagnetic Waves? (light, microwaves, radio, x-rays, etc.) (do not require a medium) Answer: Frequency ↑ frequency ↑ energy

How would the wavelength of a wave affect the energy of an electromagnetic wave?
they are inversely proportional. if one goes up the other goes down.

How do we perceive frequency?

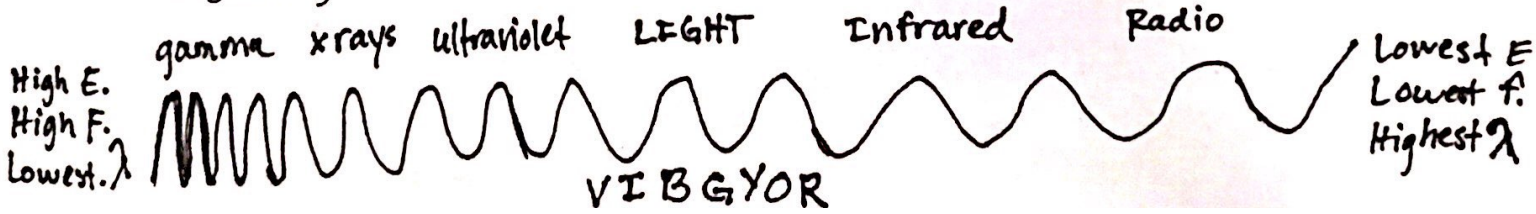
Sound (Mechanical): (Loudness is due to amplitude) Answer: Pitch → Higher the pitch, higher the amplitude

Light (Electromagnetic): Answer: Color → diff colors = diff wavelengths & frequency.

Electromagnetic Spectrum

Highest E. Highest f. Lowest λ → Gamma Rays, X-Rays, Ultraviolet, Light → Violet, Blue, Green, Yellow, Orange, Red

Lowest E. Lowest f. Highest λ → Infrared, Radio

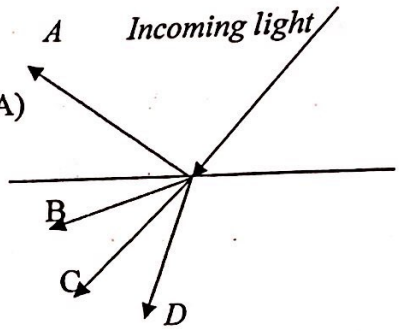


IV. Develop models based on experimental evidence that illustrates the phenomena of reflection, refraction, interference, and diffraction.

Demo: Two Spring Link

Refraction: Bending of a wave due to a change in speed as a wave travels to a different medium. (D on the diagram) – *Rainbows in prisms, Bent image in water, etc.*

Demo: Wall Ball



Reflection: Bounce back of a wave due to a change in medium. (A)

Demo: Wave Superposition Device

Interference: Combination of waves to produce a new wave.

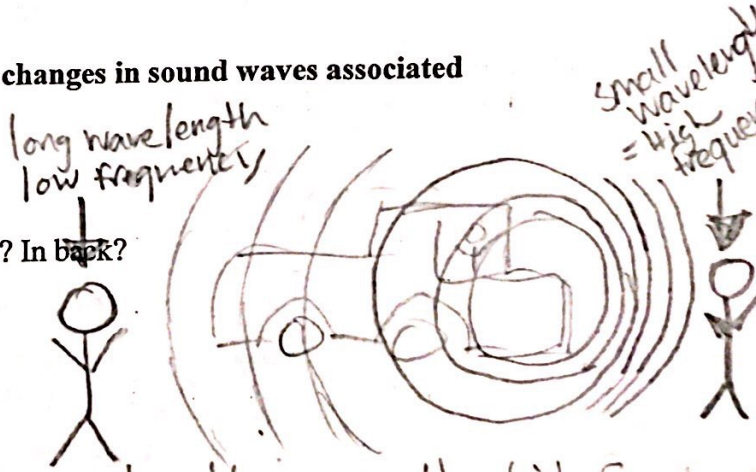
Demo: Water Wave Overhead
Reflection (coming off of the edges of the device)
Interference (Two point waves producing simultaneous waves)
Diffraction (waves through a small opening)

Diffraction: Bending of a wave due to traveling through a small opening.

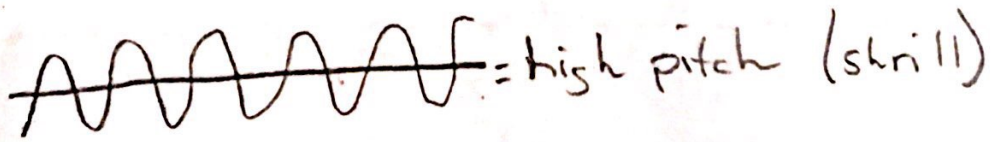
V. Develop and use models to explain the changes in sound waves associated with the Doppler Effect.

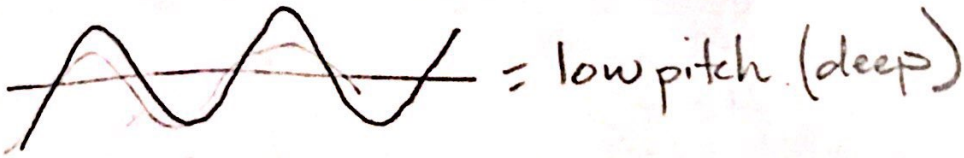
Demo: Doppler Effect

What happens to the wave in front of the motion? In back?
How would this change the pitch of the sound.
(Demo: pitch change of a motorcycle)
Doppler Radar
Shift Stars

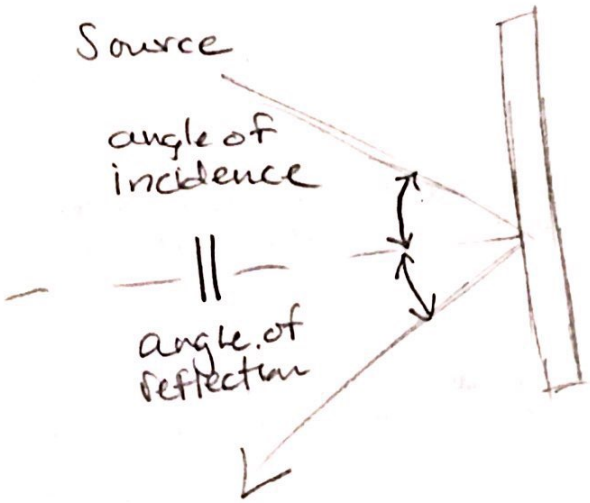


Doppler effect: – close – wavelength is small = high frequency
– farther – wavelength is larger = low frequency

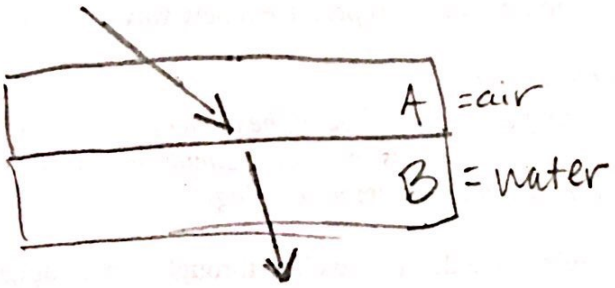




Reflection -



Refraction – the bending of a wave as it passes from one medium to another

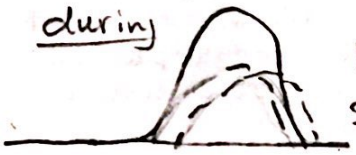


Interference – when two or more waves meet at the same point in a medium.

– constructive – 2 waves together = greater than one by itself

Before

during



light = brighter
sound = louder

– destructive – 2 waves come together & then cancel each other out.
Ex. noise canceling head phones

Diffraction: bending of light waves around a barrier or the edges of an opening

– the amount of bending depends on the size of the opening