Final Review: Wave Mechanics & Sound

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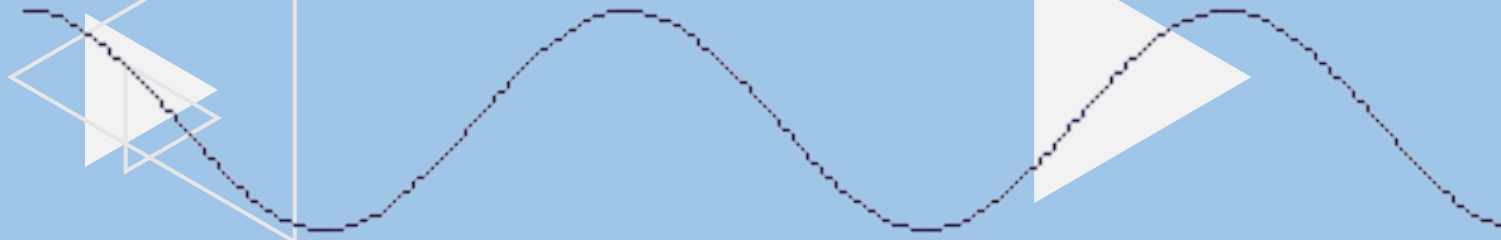
Review the Concepts:

Waves

All About a Wave



- A wiggle in time and space
- Almost always a vibration (wiggle in time)
- Basically a traveling vibration
- Carries energy to the receiver

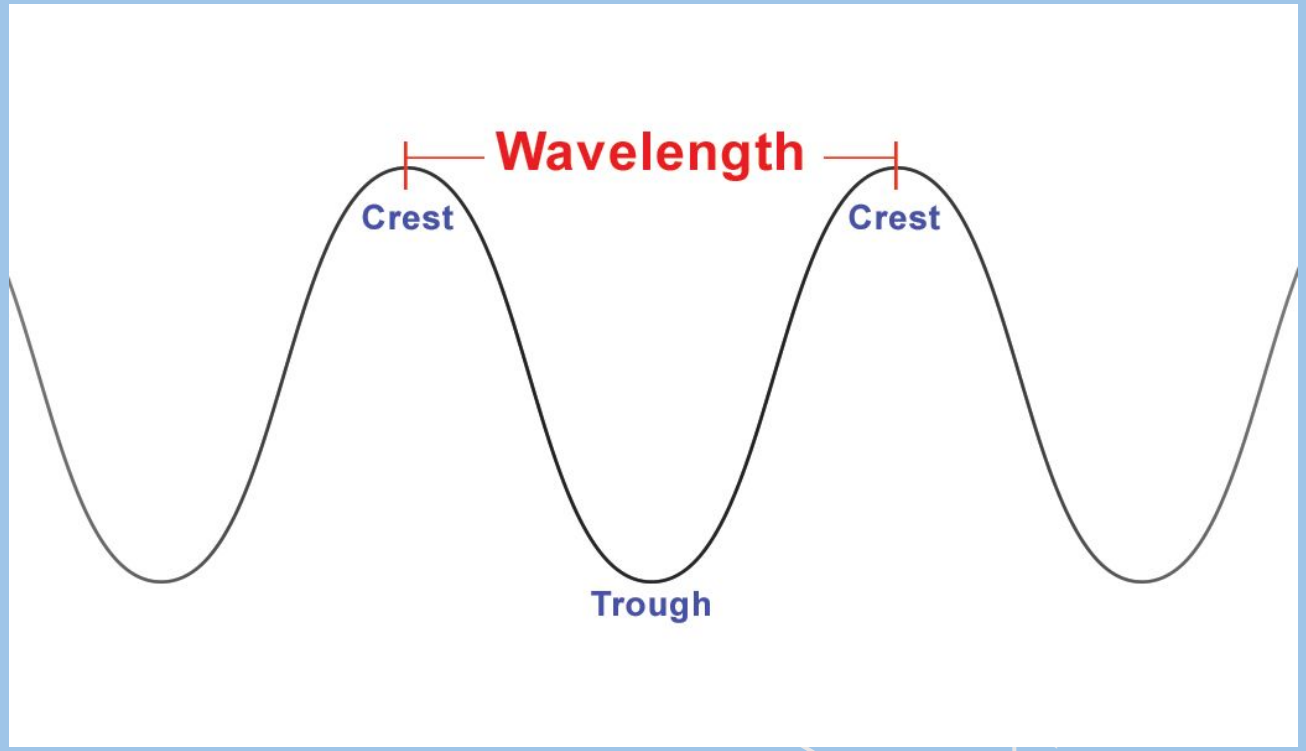
Qualities of Waves

Period (T)

- the time taken for one complete cycle of vibration to pass a given point

Wavelength (λ)

- the distance in meters between corresponding points of two consecutive waves

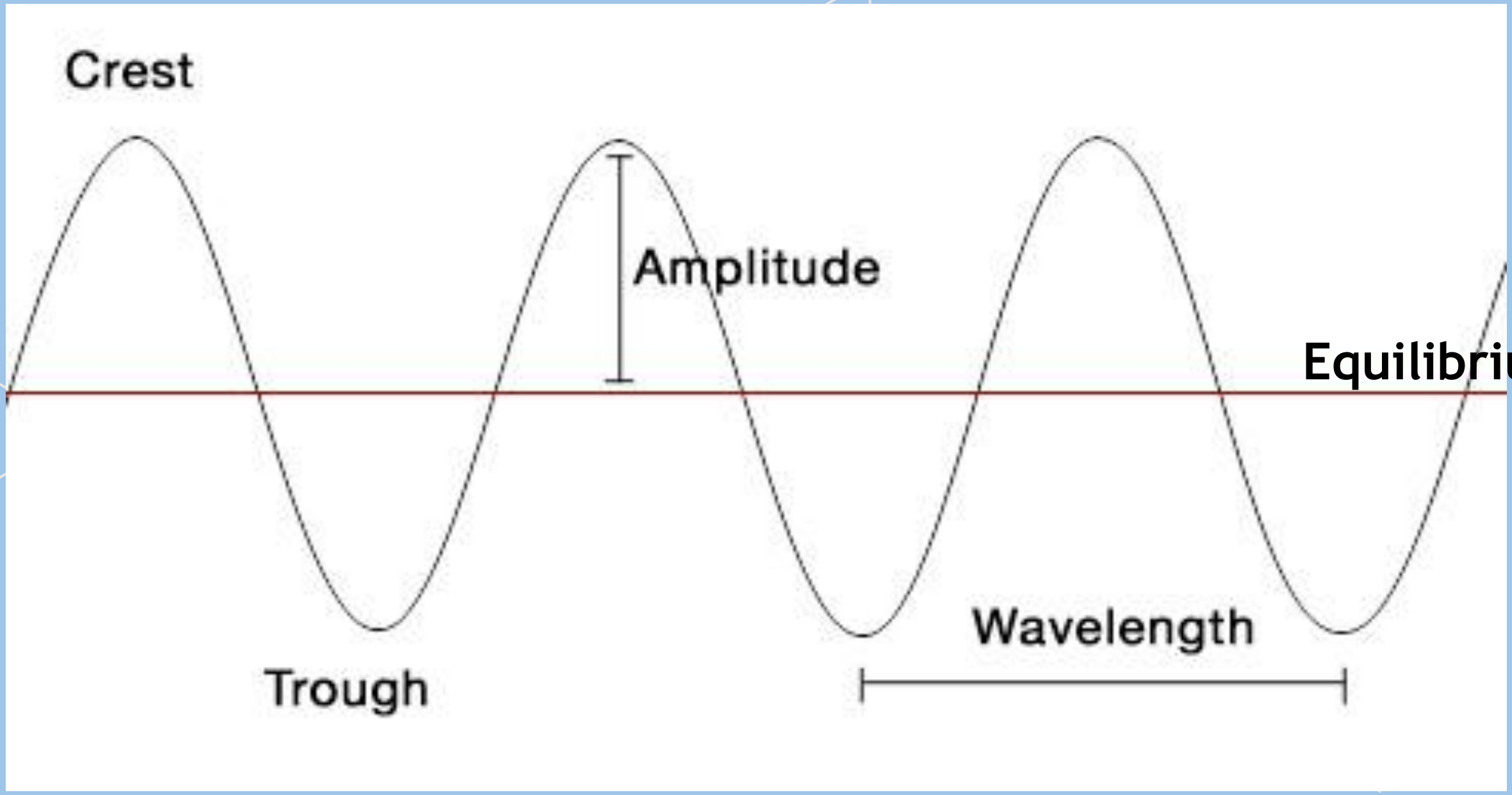


Frequency (f):

- the number of waves that pass a fixed point in one unit of time
- Unit ⇝ Hertz (Hz)
- Equation ⇝ $F = 1/T$

Velocity (v):

- Speed and direction of the wave
- Unit ⇝ m/s
- Equation ⇝ $v = \lambda f$

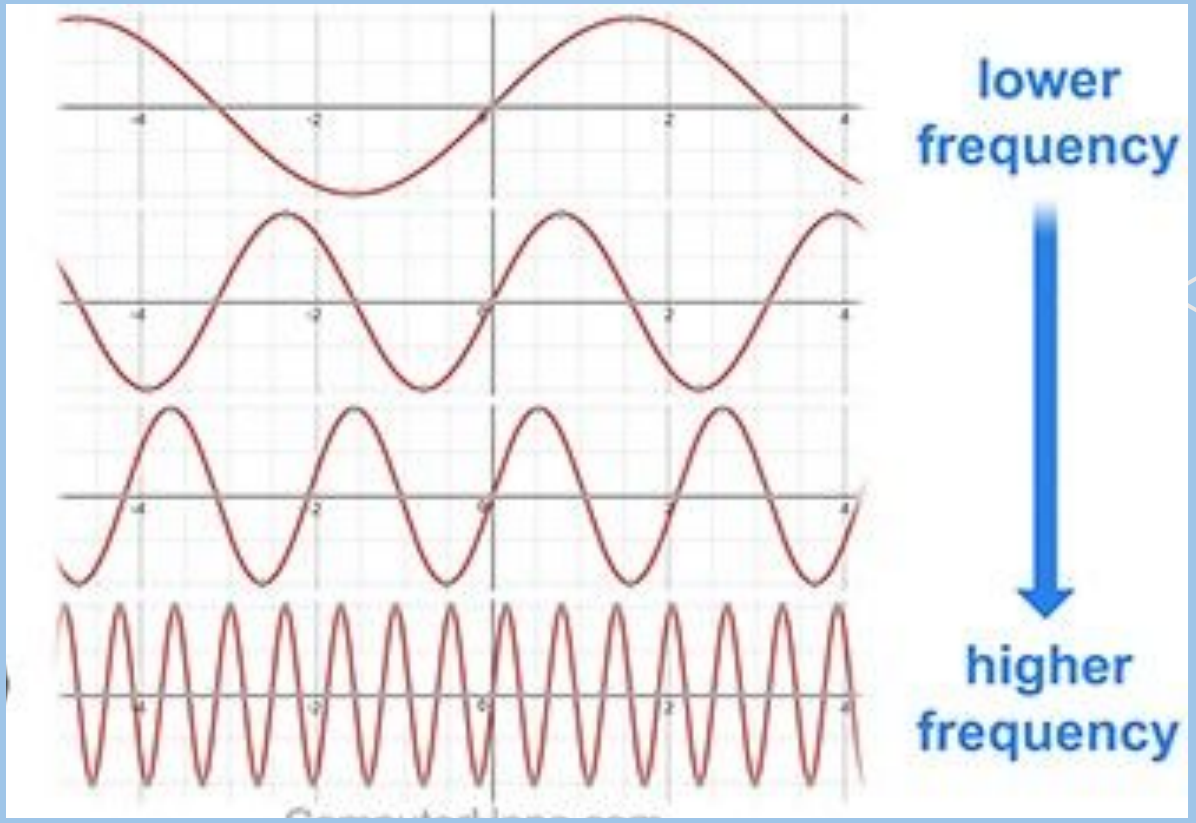

Crest
Amplitude
Equilibrium
Wavelength
Trough

Wave Speeds

- **Light wave**: 299,792 km/second or **300,000** km/second
- **Sound**: 343.59 m/s or **343** m/s
- Sound in a **vacuum: 0** m/s
    - needs a medium

If the speed of a wave stays the same...

- the wavelength decreases when the frequency increases
- the wavelength increases when the period increases



- Motion of the direction as in which the wave tr s

Interference

- Occurs when two or more waves meet
- Interference patterns may appear when parts of the waves overlap

Constructive:

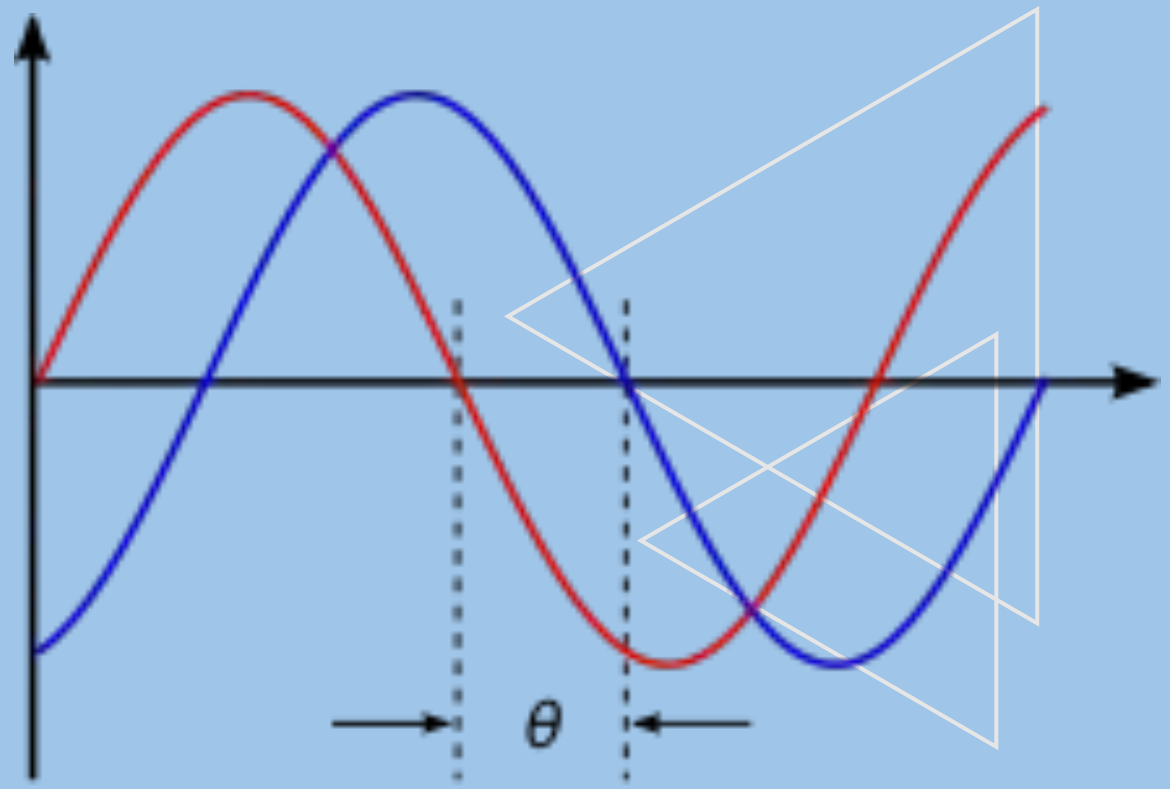
- when the crest of one wave overlaps with the crest of another, their individual effects add up ↠ greater amplitude

Destructive:

- when the crest of one wave meets the trough of another, their individual effects decrease ↠ reduced amplitude

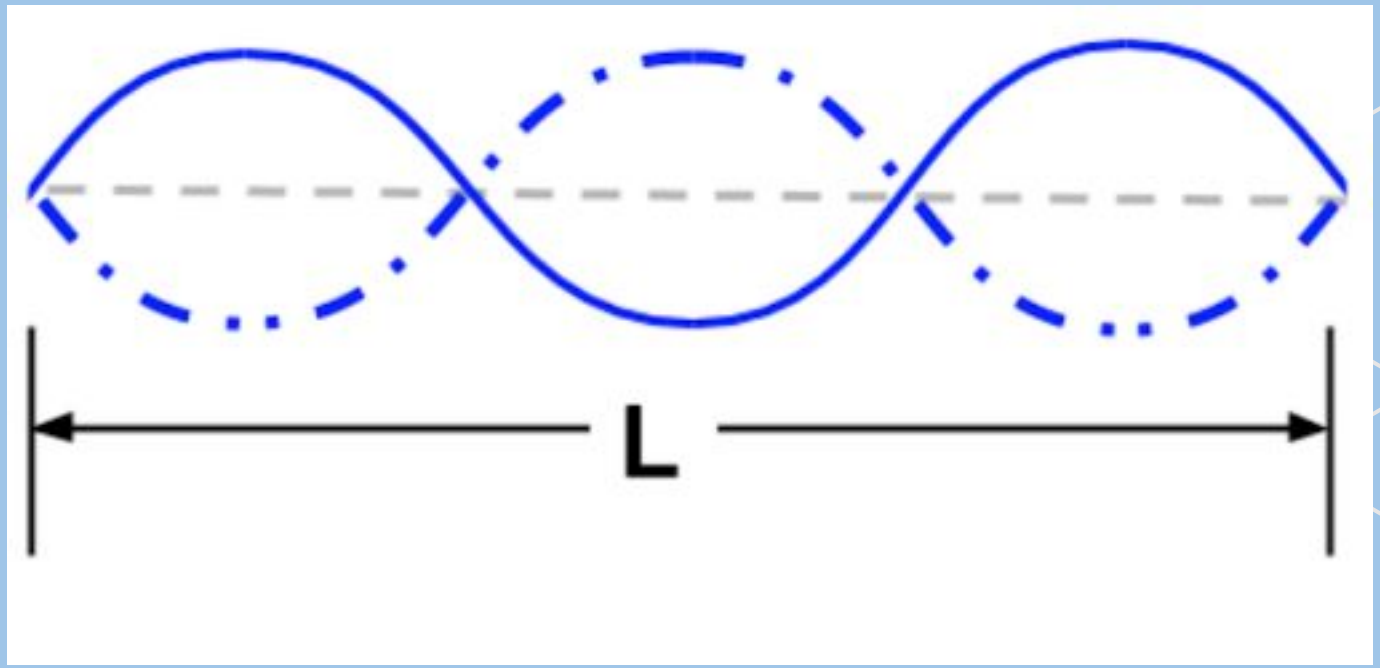
Phase

the relationship between the period of a wave and an external reference point



Standing Waves

- One where particular parts on the waves are “fixed”
- End points = nodes



Review the Concepts:

Sound

A Little About Sound

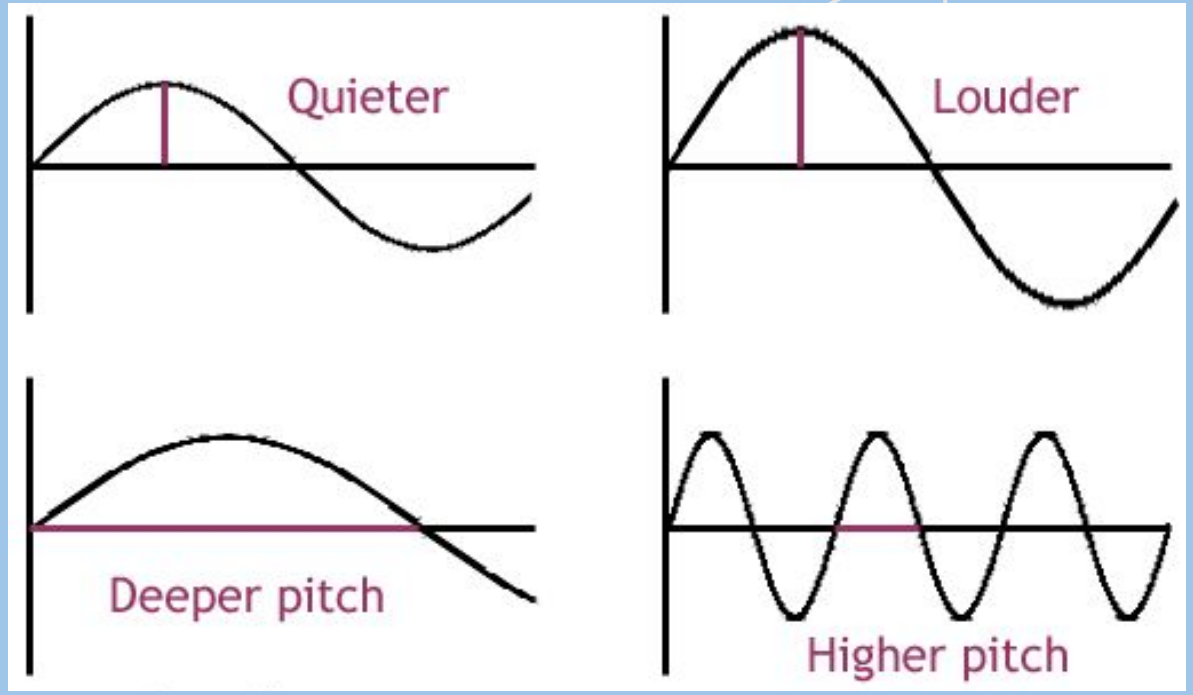
- Produced by vibrations
- Those vibrations compress and decompress the air around the vibrating object
- The frequency of the vibrating source almost always equals the frequency of the sound waves

Harmonic Series

- The series of all multiples of a base frequency

Pitch

- Our brain's interpretation of frequency

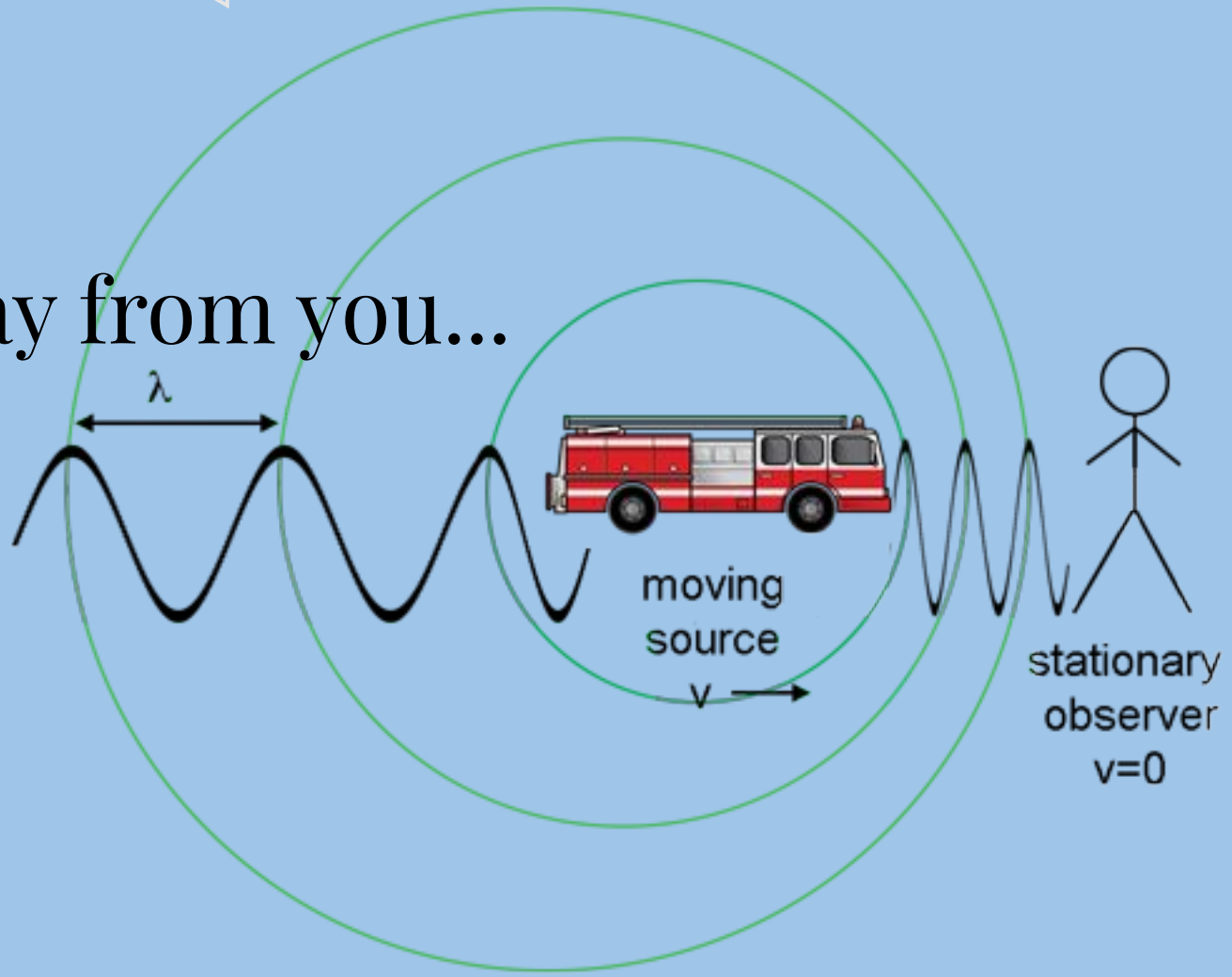


If an object is moving towards you...

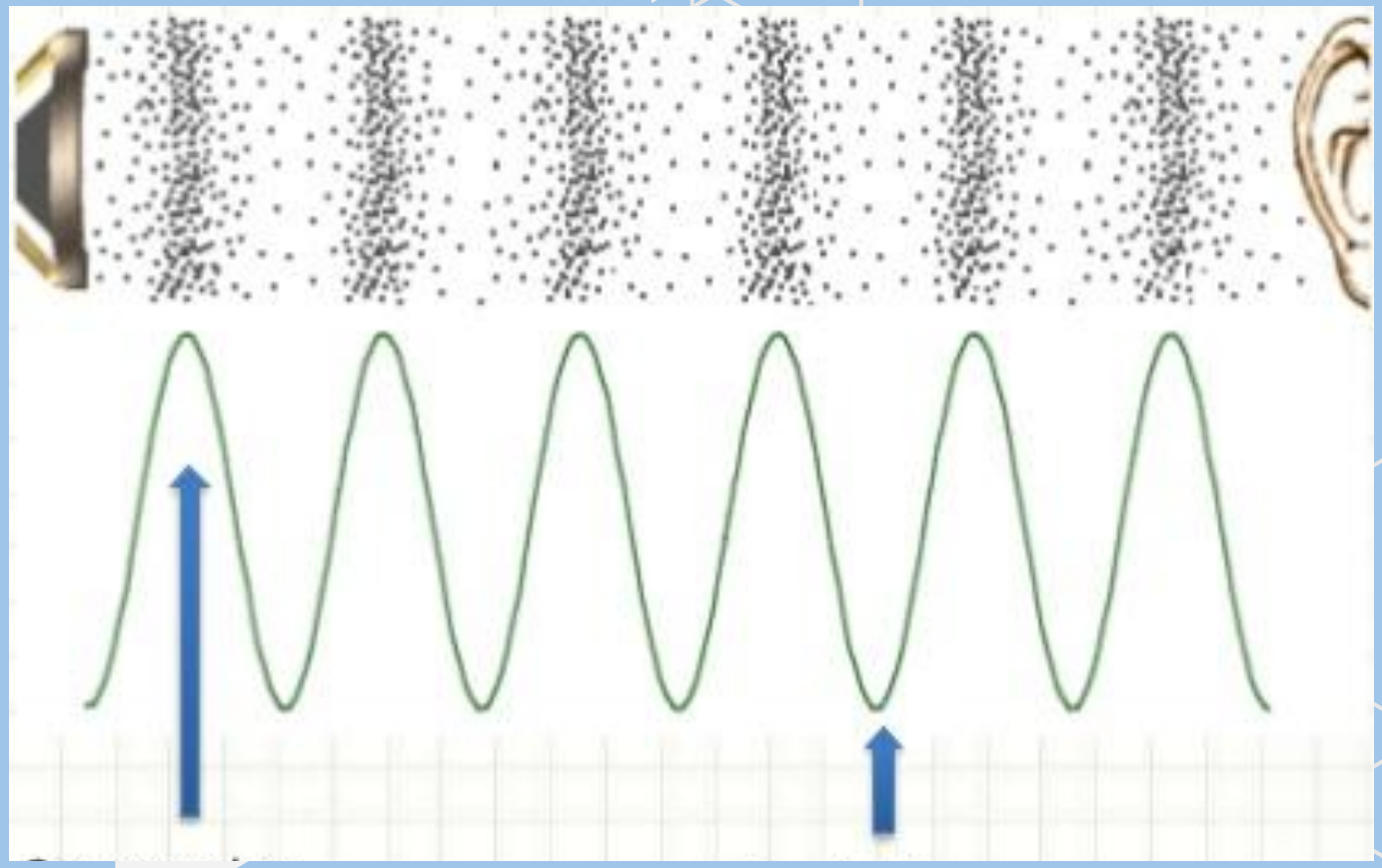
pitch ↠ higher

If an object is moving away from you...

pitch ↠ lower



Pressure



Compression
(High pressure)

Rarefaction
(Low pressure)

Sound Speeds

- **AIR** at **343** meters per second
- **WATER** at **1,482** meters per second
- **STEEL** at **6,000** meters per second

solids > liquids > gasses

Intensity and Shape

- Power Per Area (Power/Area)
- Sound waves travel in the shape of a sphere
- Decibel scale is loudness
- For every increase in 10 decibels, the sound intensity increases by a factor of 10

Natural Frequency

- The frequency at which minimum energy is required to produce and sustain forced vibrations

- It depends on the elasticity and shape of the vibrating object

- Timbre: the character or quality of a musical sound or voice as distinct from its pitch and intensity

Resonance

- frequency of a forced vibration = natural frequency
    - dramatic increase in amplitude