

# Final Review: Wave Mechanics & Sound

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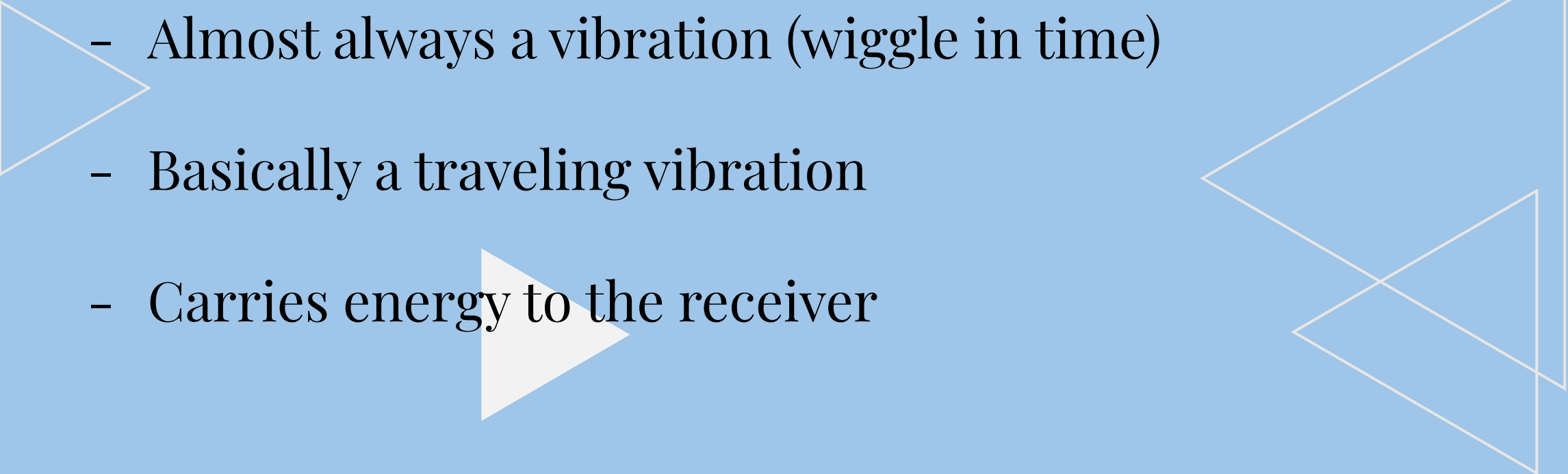


*Review the Concepts:*

# Waves

# All About a Wave

A decorative graphic at the top of the slide features a black sine wave on a light blue background. Several overlapping triangles are scattered around the wave: a solid yellow triangle pointing right, a white triangle with a black outline pointing right, a white triangle with a black outline pointing left, and a white triangle with a black outline pointing right.

- A wiggle in time and space
  - Almost always a vibration (wiggle in time)
  - Basically a traveling vibration
  - Carries energy to the receiver
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- A decorative graphic on the right side of the slide consists of several overlapping triangles. There is a white triangle with a black outline pointing left, a white triangle with a black outline pointing right, and a white triangle with a black outline pointing right.



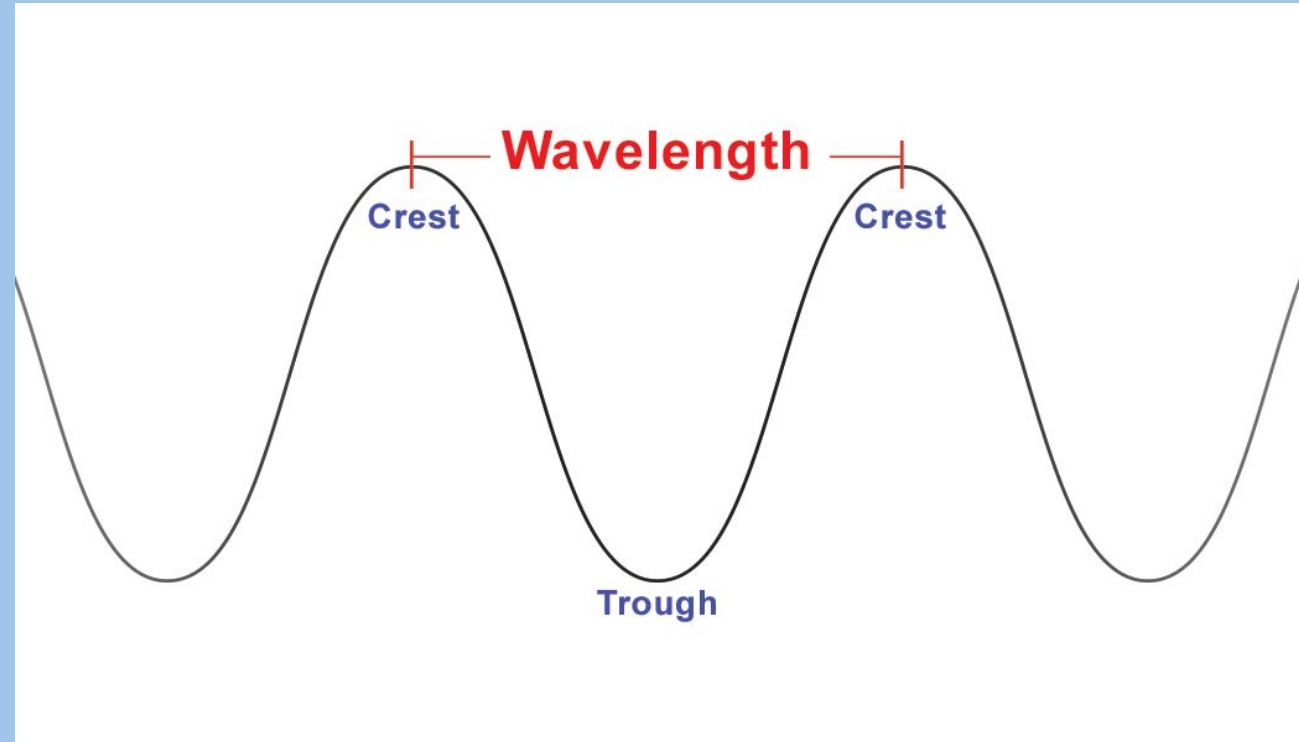
# Qualities of Waves

## Period (T)

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

## Wavelength ( $\lambda$ )

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



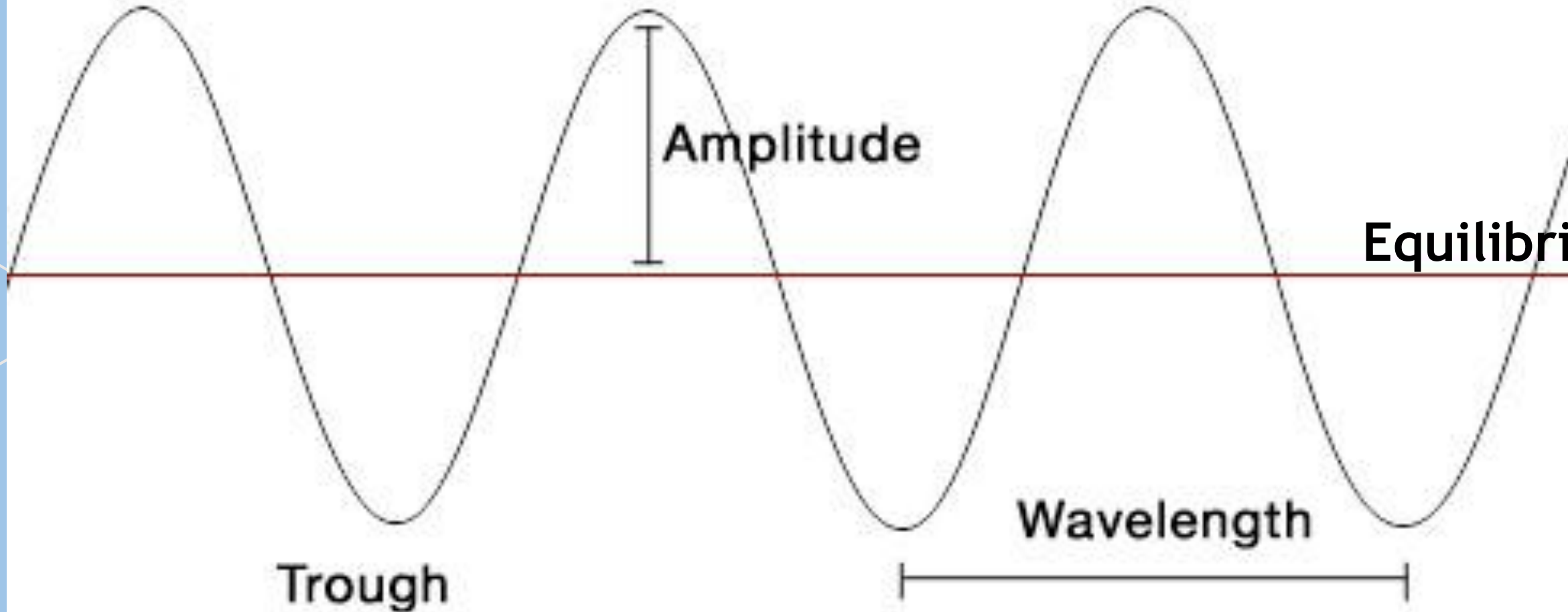
## Frequency ( $f$ ):

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

## Velocity ( $v$ ):

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

**Crest**



**Equilibrium**

**Trough**

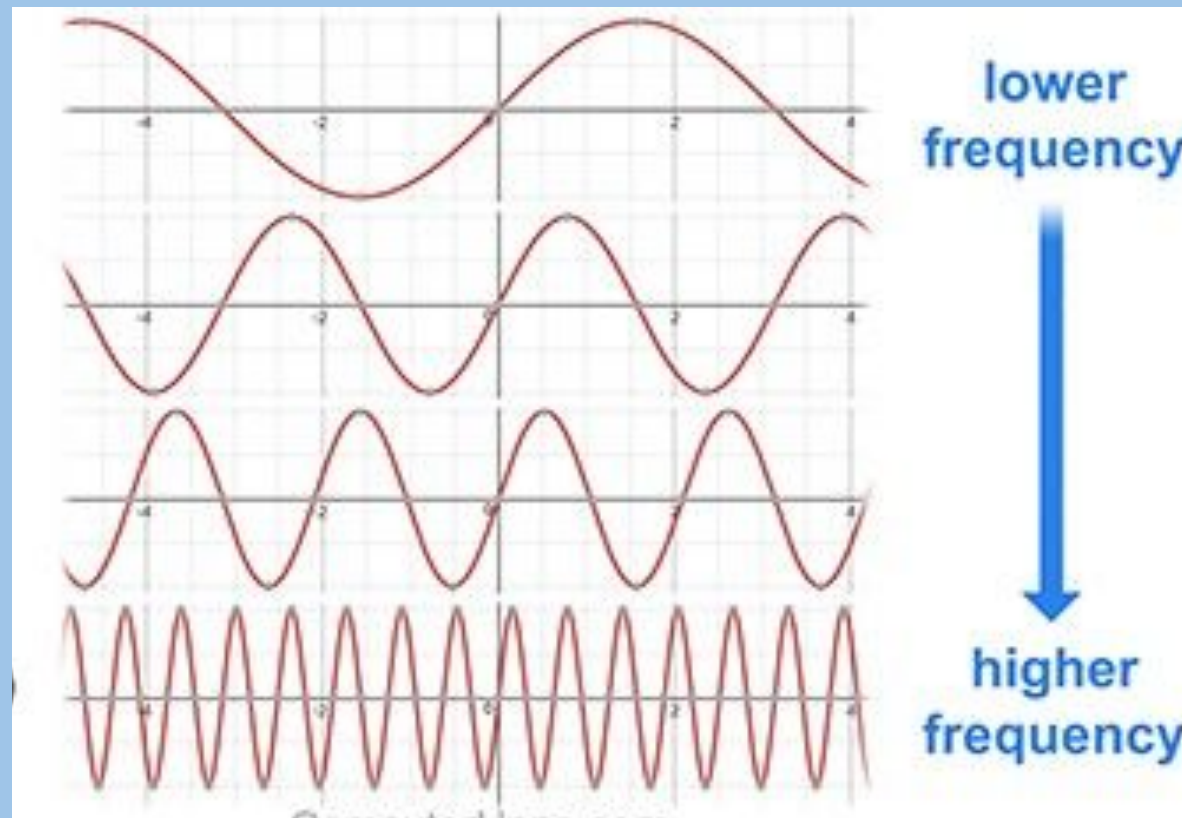
**Wavelength**

# 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







# LONGITUDINAL WAVE




- Motion of the particles is perpendicular to the direction of wave propagation as in a transverse wave.
- which the wave travels

AQ1

# Interference



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

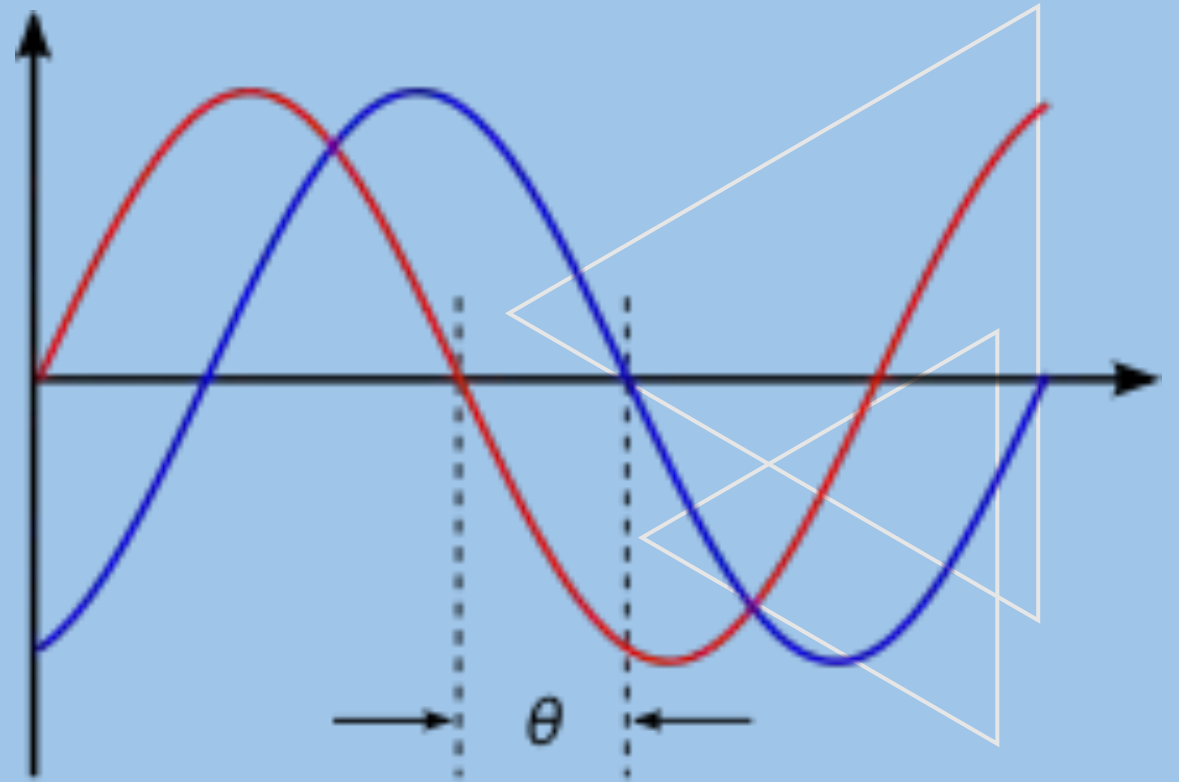
- when the crest of one wave overlaps with the crest of another, their individual effects add up  $\Rightarrow$  greater amplitude

## Destructive:

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

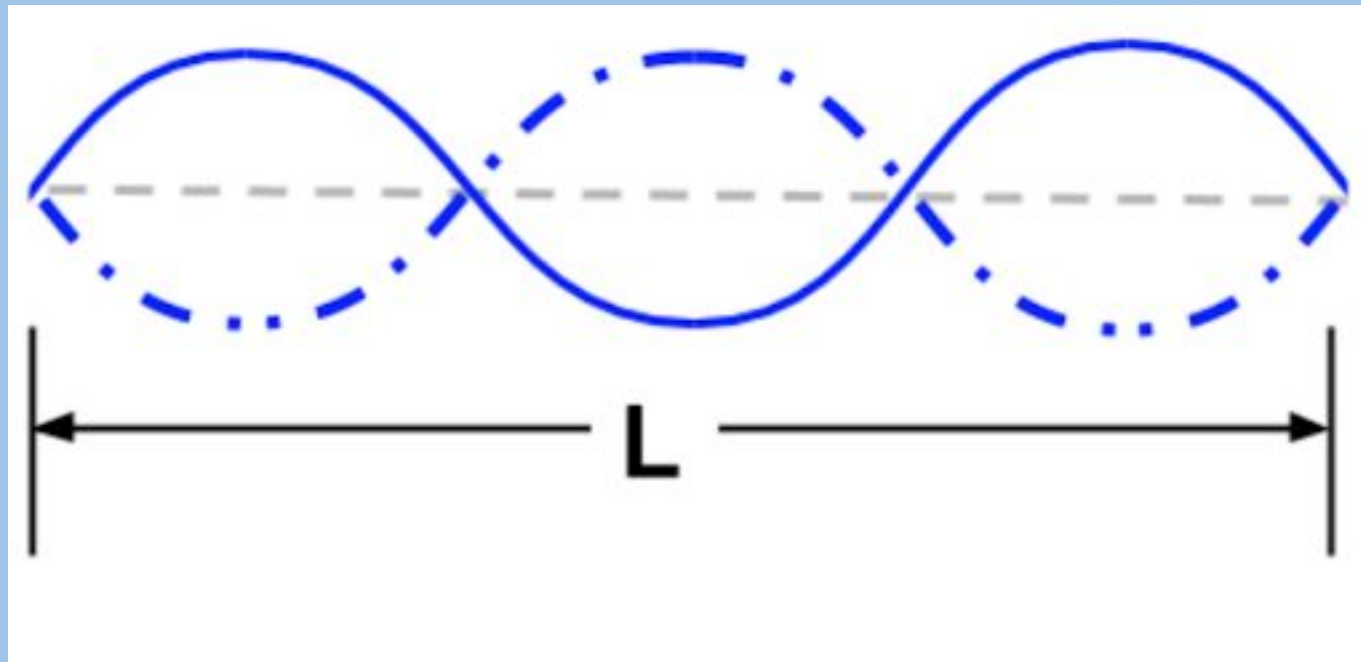
# Phase

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



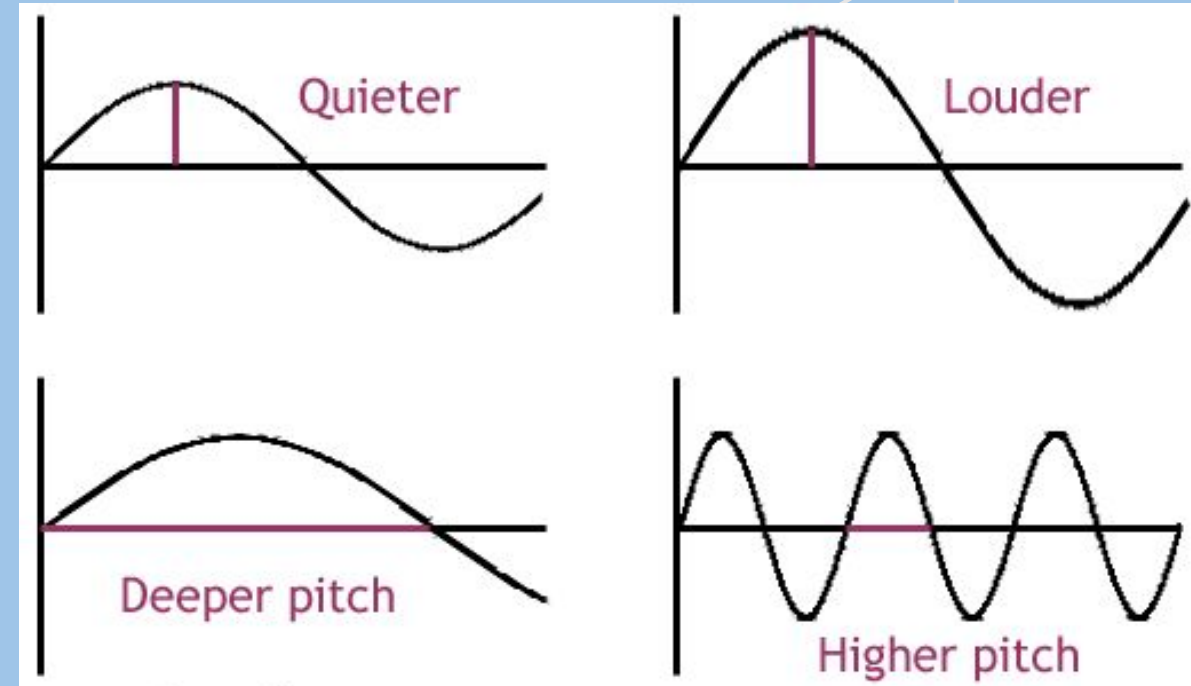
- Produced by vibrations
- Those vibrations compress and decompress the air around the vibrating object
- The frequency of the vibrating source almost always equals the frequency of the sound waves

# Harmonic Series

- The series of all multiples of a base frequency

## Pitch

- Our brain's interpretation of frequency

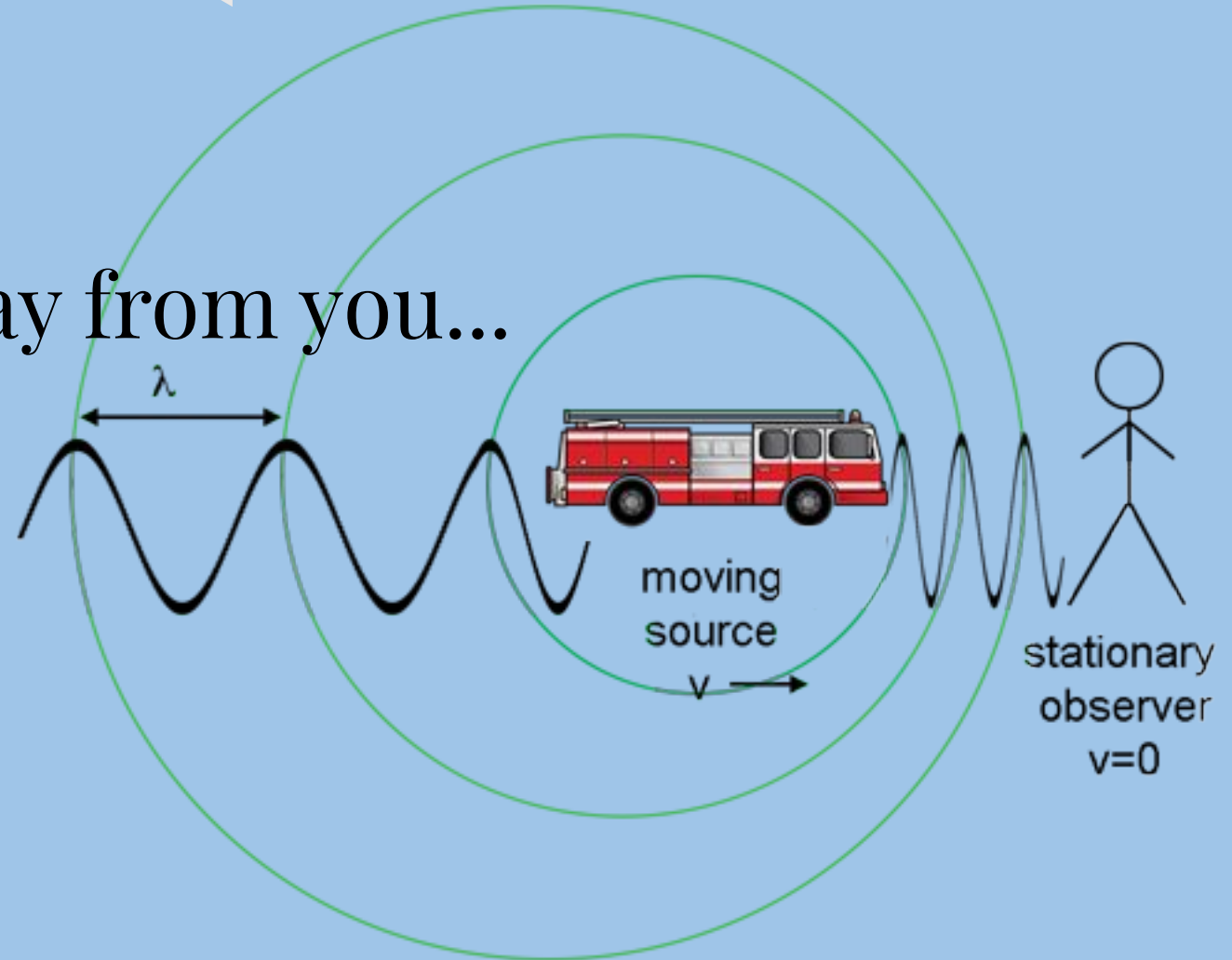


If an object is moving towards you...

pitch  $\Rightarrow$  higher

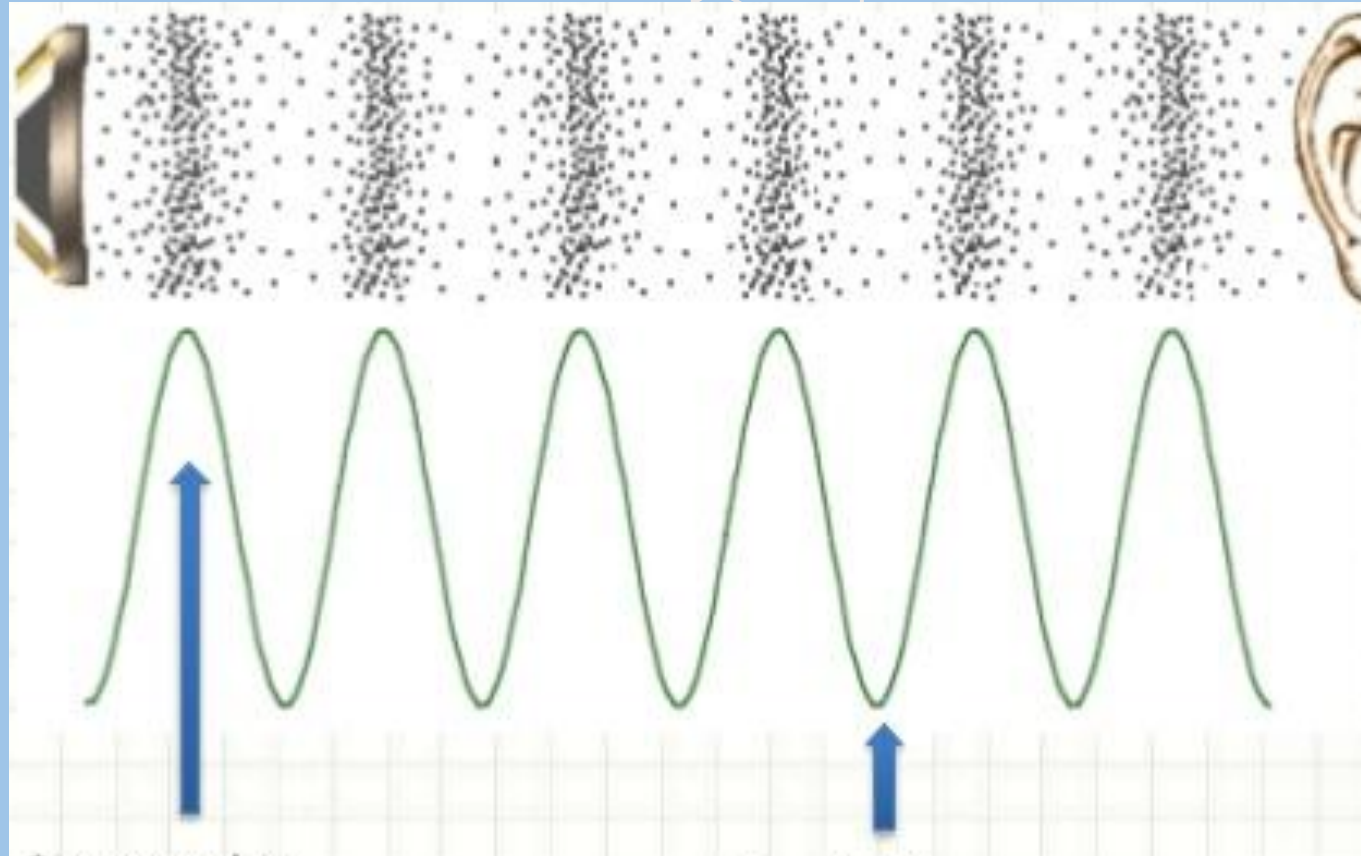
If an object is moving away from you...

pitch  $\Rightarrow$  lower





# Pressure



Compression  
(High pressure)

Rarefaction  
(Low pressure)



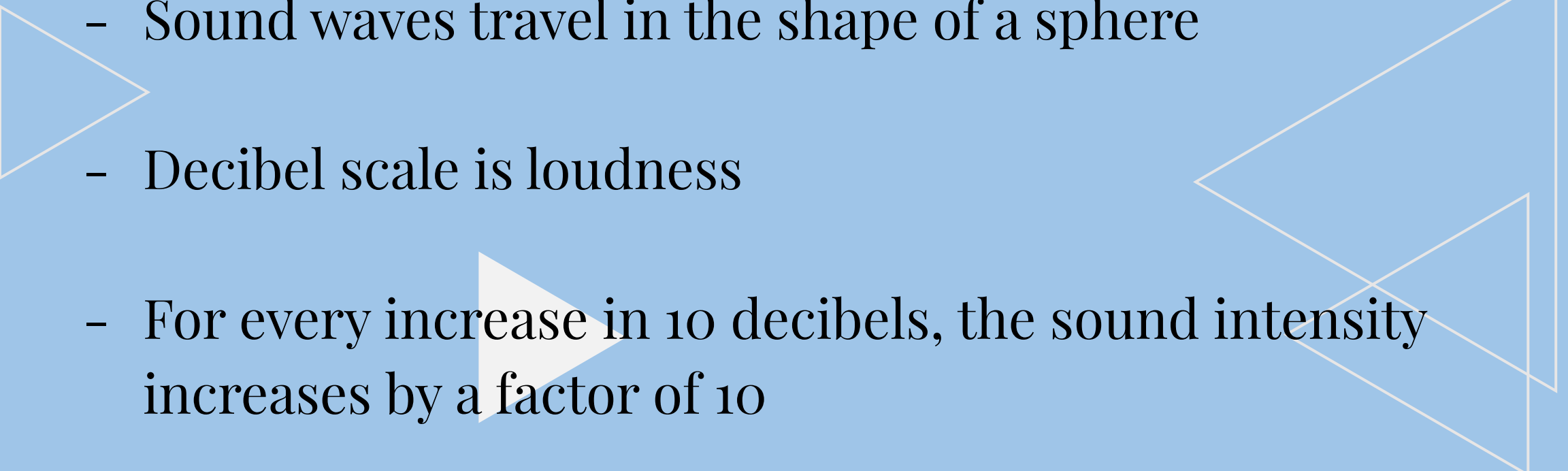
# Sound Speeds

- **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

A light blue background with several white triangles of various sizes and orientations scattered across the slide. Some are solid, some are outlines, and some are semi-transparent.

- 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
- 
- A light blue background with several white triangles of various sizes and orientations scattered across the slide. Some are solid, some are outlines, and some are semi-transparent.

# 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

