

### III. Chapter 8 - Sound

- a. Sounds are longitudinal waves that require a medium to travel caused by the vibrations of an object.
- b. The speed of sound depends on the elasticity, density and temperature of the medium.
  - i. Elasticity – the ability of an object to bounce back to its original shape. Sound travels faster in more elastic objects. Typically gasses are the least elastic, liquids are next and solids are the most elastic.
  - ii. Density – generally speaking, the denser the medium the slower the sound travels.
  - iii. Temperature – generally speaking the higher the temperature the faster the speed of sound.
  - iv. Chuck Yeager – first man to fly faster than the speed of sound
  - v. Andy Green – first man to drive a land vehicle faster than the speed of sound.

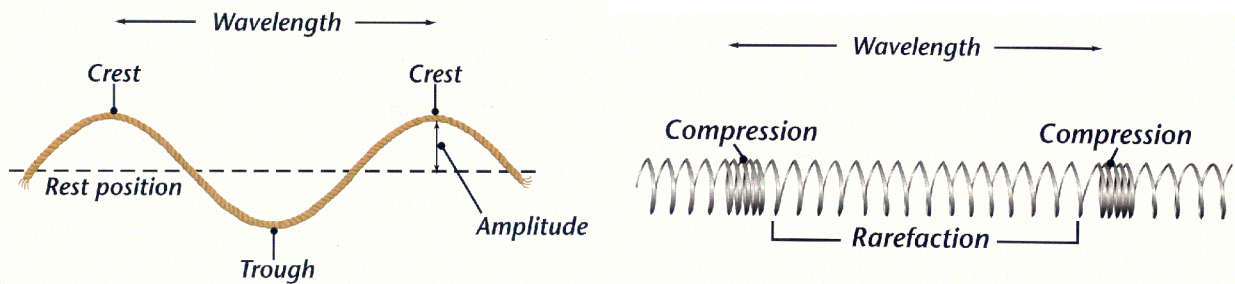
#### c. Properties of Sound

- i. Intensity – the amount of energy the wave carries per second per meter squared
  1. intensity = Watts / m<sup>2</sup>
- ii. Loudness – sound level is measured in decibels (dB)
  1. whisper = 20 dB
  2. rock concert = 115 dB
  3. rocket engine = 200 dB

Vocabulary	Definition
Acoustics	The control of noise & the vibrations that cause noise
Compression	Area where the waves are pushed together
Compressional	Type of wave where medium vibrates in the same direction as the movement
Decibels	The intensity of sound is measured in these units
Doppler	The change in frequency caused by the motion of the object
Fundamental	The lowest frequency in a musical sound
Harmony	Overtone w/ whole number multiples frequencies of the fundamental
Interference	The combination of two or more sound waves
Loudness	As the amplitude increase, the loudness increases
Octave	Eight notes on the musical scale
Overtone	Has a higher frequency than the fundamental frequency
Pitch	Dependant on the frequency of the wave
Rarefaction	Area of a sound wave where the wave is pulled apart
Ultrasonic	Sounds too high to be heard by humans
Vacuum	Sound waves require a medium to travel & cannot travel through a vacuum

#### d. Human Sound

- a. Converting sound waves (vibrations) into sensory impulses interpreted as sound.
- b. Three parts to your ear: Outer Ear, Middle Ear and Inner Ear
  - i. **Outer Ear:** The funnel shaped **ear flap (pinna)** and the **auditory canal** direct sound to the **eardrum (tympanum)** which separate the outer and middle ear
  - ii. **Middle Ear:** The sound waves vibrate the tympanum which causes the three smallest bones in the body to also vibrate. These bones (in order) are the **Hammer (Malleus)**, **Anvil (Incus)** and **Stirrup (Stapes)**. The end of the stirrup vibrates a thin membrane, the **Oval Window**, covering the inner ear. The **Eustachian tube** connects the middle Ear with the back of the throat (Pharynx) to allow atmospheric pressures to equalize on each side of the **tympanum**.
  - iii. **Inner Ear:** The **Oval Window** separates the middle and inner ears. This membrane touches the fluid filled chamber of the **cochlea** causes the **Cochlea** to vibrate. The inner surface of the cochlea is lined with tiny nerve receptor **Hair Cells**. These receptors stimulate the neurons of the **auditory nerve (Vestibulocochlear Nerve)** which carries impulses to the cerebrum where it is interpreted as sound.



## The Structure of the Human Ear

