Physical Science

Chapter 8

Sound

Sound

- Sounds are longitudinal waves that require a medium to travel caused by the vibrations of an object.
- **Speed of Sound – on average:**
  - **Air is 767 mph (343 m/s) – about 1 mile every 5 sec**
  - **Water is 3,315 mph (1,482 m/s)**
  - **Steel is 13,330 mph (5,960m/s)**
- The speed of sound depends on the elasticity, density and temperature of the medium.

Sonic Boom follows

Speed of Sound

- Speed of Sound: depends on the elasticity, density and temperature
- 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.
- Density – generally speaking, in material of the same state of matter (solid, liquid or gas) the denser the medium the slower the sound travels. Sound travels slower in lead than it does in steel.
- Temperature – generally speaking the higher the temperature the faster the speed of sound.

Breaking the Sound Barrier

- **Chuck Yeager** – first man to fly faster than the speed of sound
- **Andy Green** – first man to drive a land vehicle faster than the speed of sound.

October 14, 1947 –
in X1 "Glamorous Glennis"

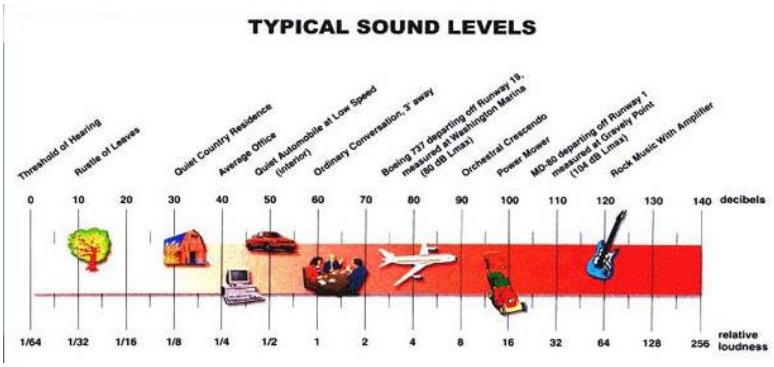
October 15, 1997 –
in SuperSonic Car
"Thrust SSC"
763 MPH

Properties of Sound

- **Intensity** – the amount of energy the wave carries per second per meter squared

intensity = Watts / m2

- **Loudness** – sound level is measured in **decibels** (dB)



Frequency & Pitch

- **Frequency** – the number of vibrations per second
  - Human Hearing – between 20 Hz – 20,000 Hz
    - Below 20 Hz is called infrasound
    - Above 20,000 Hz is called ultrasound
- **Pitch** - dependent of frequency
  - high frequency yields high pitch sounds
  - Low frequency yields low pitch
- **Resonance** – when the frequency of sound matches the natural frequency of an object

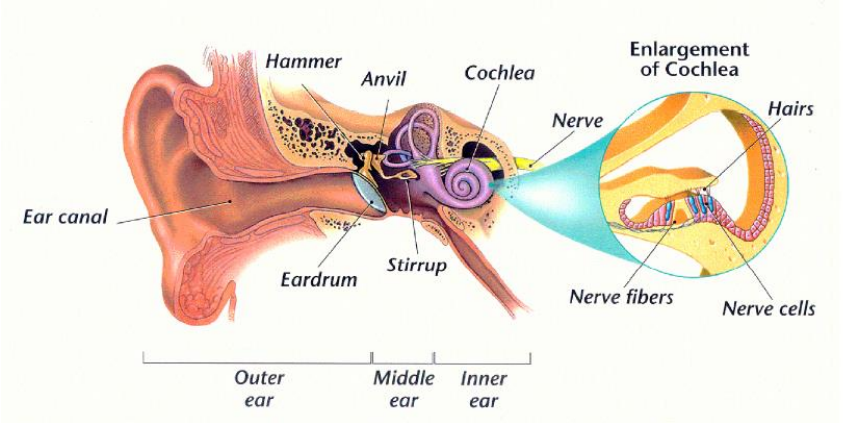
Tacoma Narrows Bridge collapse

A Perfect Matching or a Bunch of "Fill-in-the-Blanks"

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	Overtones 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

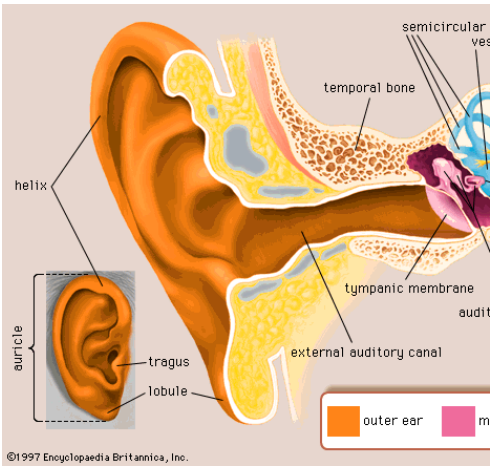
Hearing – Human Sound

Need to know these structures & their function: Outer Ear, Middle Ear, Inner Ear, Pinna, Auditory canal, Tympanum, Malleus, Incus, Stapes, Oval Window, Cochlea, Auditory Nerve, Semicircular Canals, Eustachian Tube



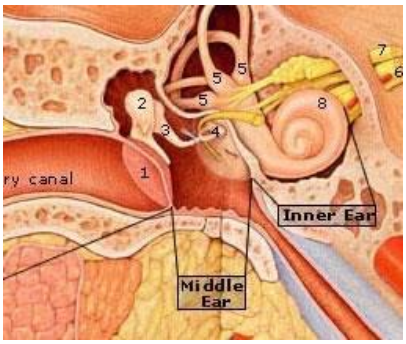
Outer Ear

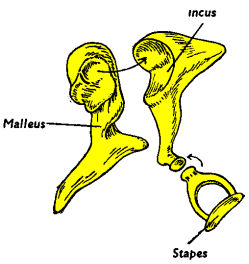
- Pinna- (the ear flap aka auricle), used to focus the sound waves into the ear canal
- External Auditory Meatus – the "hole through the temporal bone that opens the space for the ear canal, the middle & inner ears
- Auditory Canal – (ear canal), focuses the sound onto the ear drum
- Tympanic membrane – (ear drum), end of the outer ear, beginning of the middle ear. Sound starts the ear drum vibrating.



Middle Ear

- Tympanic membrane vibrates
- Causing the 3 smallest bones in to vibrate, one after the next
  - Malleus (hammer) is touching the ear drum & vibrates first
  - Next is the Incus (anvil)
  - Last is the Stapes
  - Eustachian Tube: tube that connects the middle ear w/ the pharynx. This allows the pressure on both sides of the ear drum to equalize.



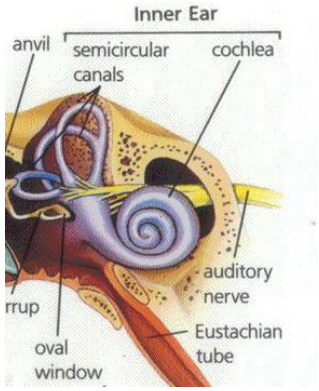


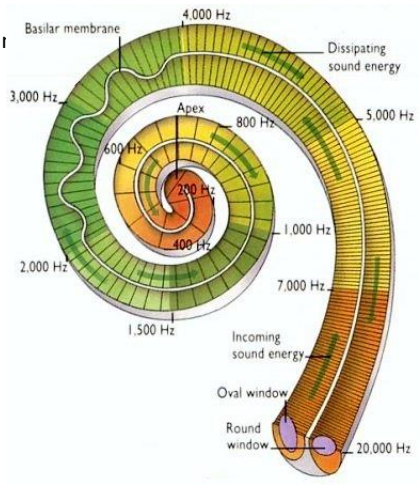
The Bones of the Middle Ear.

Inner Ear

The Stirup vibrates the oval window of the cochlea. Cochlea is a long fluid filled tube, folded in half and the coiled up like a snail shell. The entire inner surface is lined w/ cillia. Attached to the cillia is a nerve fiber. Once cillia are vibrated, the attached
nerves are stimulated & send signal to the brai

Balance **is achieved by the** semicircular canals.
3 canals in 3 different planes are able to determine body position in space





That's all Folks …
Learn it…
Live it…
Love it !!!