

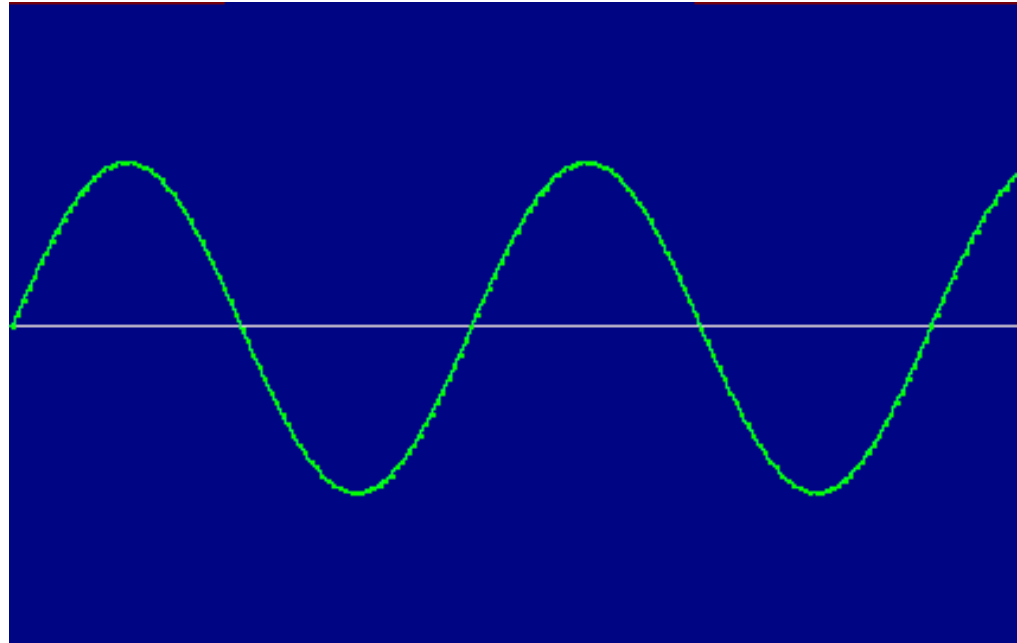
SPEED OF SOUND WAVEFRONT

Sound Waves



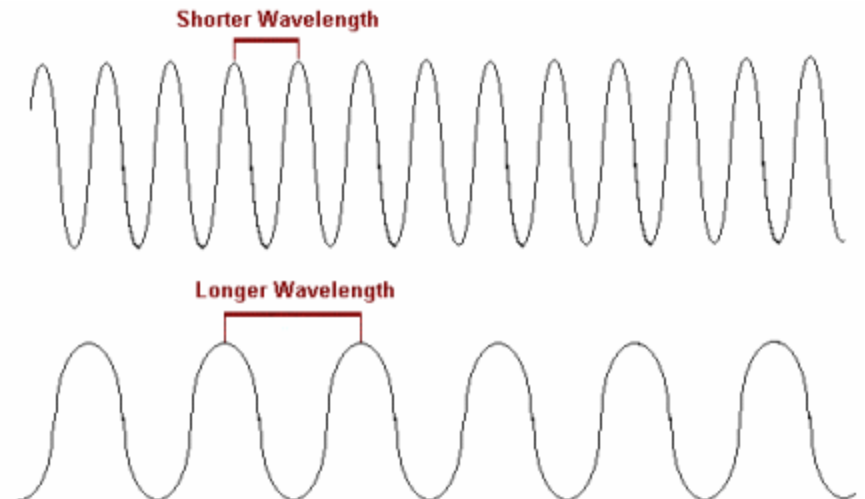
Characteristic of Waves

- **A wave is a rhythmic disturbance that transfers energy through space & matter (medium)**
- **Wave description**
 - **Crest or Hill**
 - **Trough or Valley**



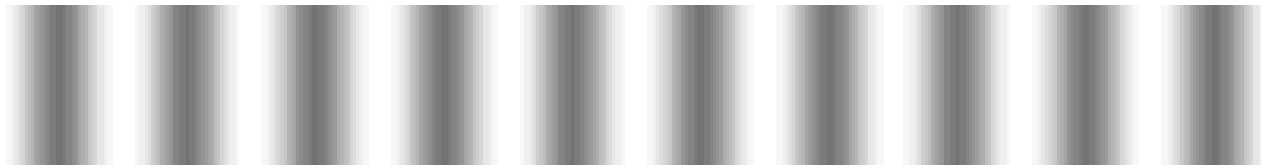
Wave Measurements

- **Wave length** – the distance from crest to crest or trough to trough
- **Amplitude** – distance a wave rises and falls from rest
- **Frequency** is the number of waves to pass a given point in 1 second
- The unit for wave frequency is hertz Hz
Waves/second
- **Wave length/time=velocity & # waves/second=Frequency**
- **Velocity=wavelength x Frequency**
 - The speed of the wave depends on its wavelength and frequency



Sound Waves

- **Sound waves are longitudinal waves**
Wave that vibrates in the same direction as it travels
- **Areas where the air molecules are close together is the compression and where the molecules are spread apart is rarefaction**



Velocity of sound

- **Air 0oC 332 m/s**
- **Water 1454 m/s**
- **Wood 3828 m/s**
- **Iron 5103 m/s**
- **Stone 5971 m/s**
- **You can tell how far you from something by the time it takes for the echo to return divided by 2 sample problem in the book**

Volume

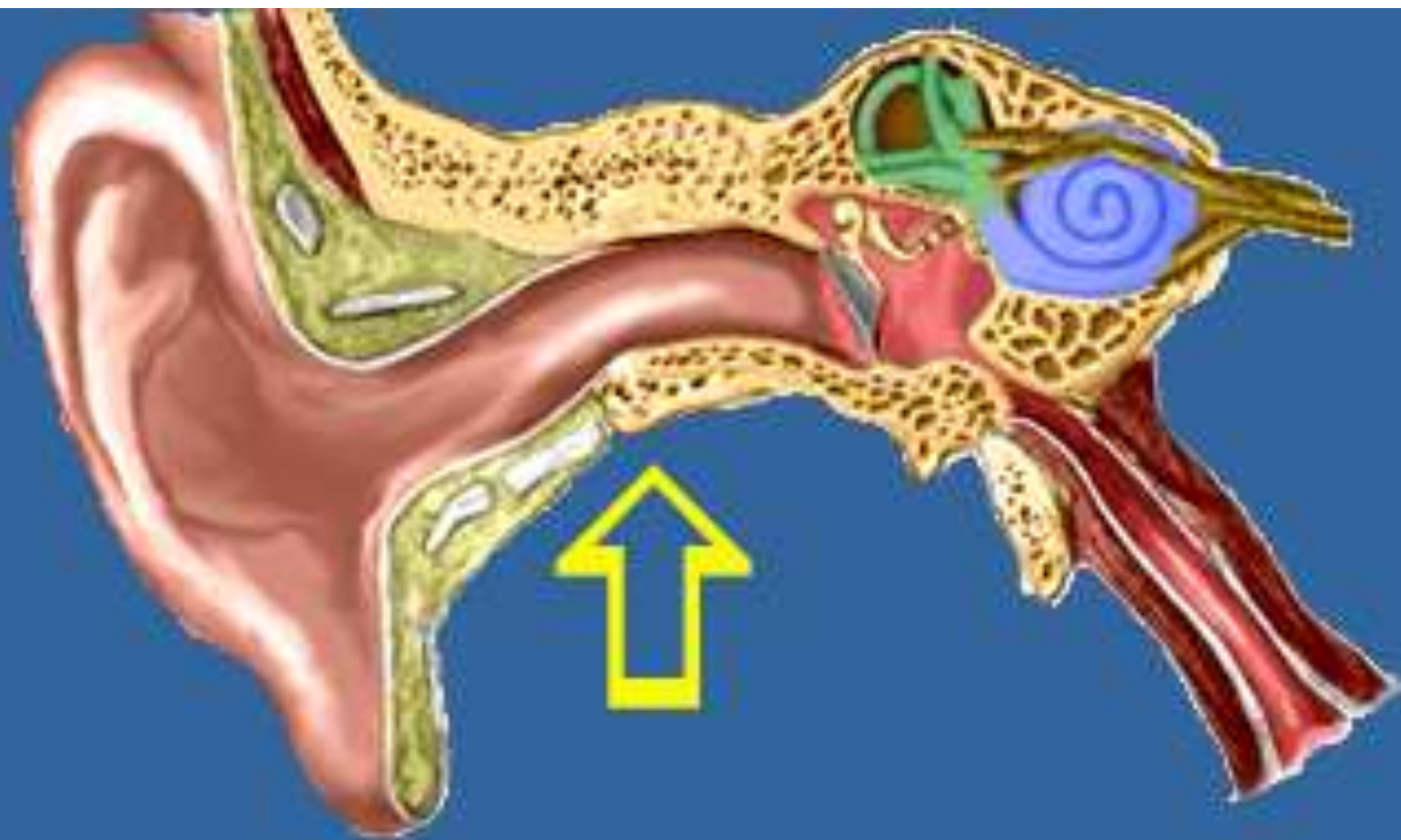
- **the loudness of sound**
- **Amplitude – The greater the vibration of air molecules that reach your ears, the greater the volume of sound**
- **Volume is measured in units called decibels**
 - **0 dB just below what can be heard**
 - **90 dB can damage ear drum**
 - 120 dB cause pain**

Pitch

- **the highness and lowness of sound**
Pitch is frequency is measured in Hz
- **People hear between 18 and 20,000 Hz**
- **\Elephants communicate with sounds of 10 Hz**
- **Bats 40,000 Hz**

The human ear

- **Outer ear – catch sound waves**
 - **Canal takes the vibrations to the eardrum**
 - **Eardrum vibrates when the sound hits it**
 - **Middle ear**
 - **Three tiny bones**
 - **Hammer anvil and stirrup amplify sound**
 - **Stirrup connected to the oval window the membrane of the inner ear**



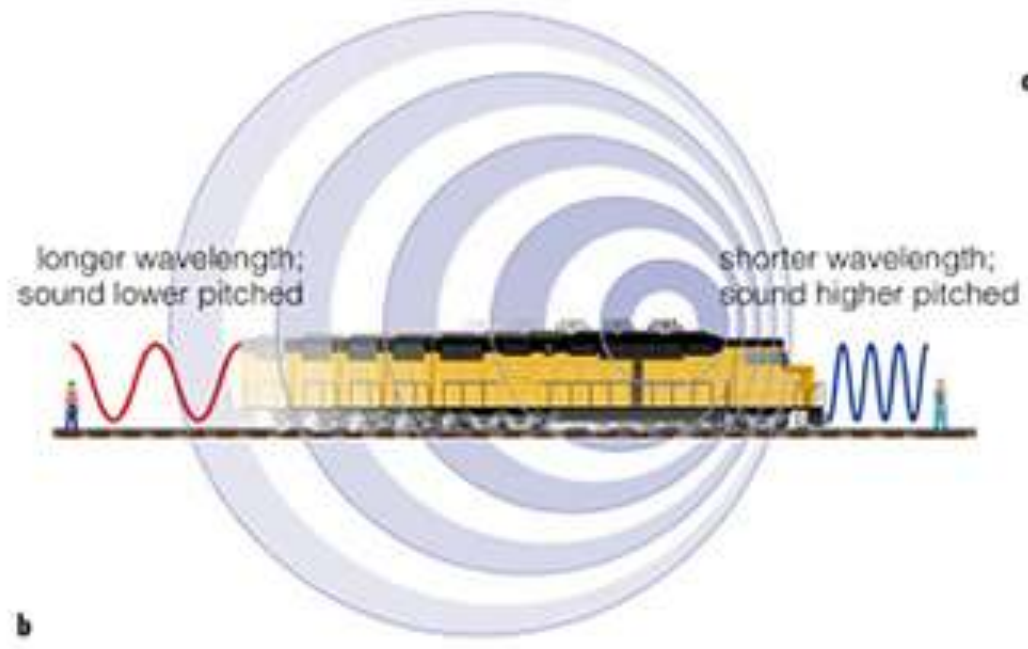
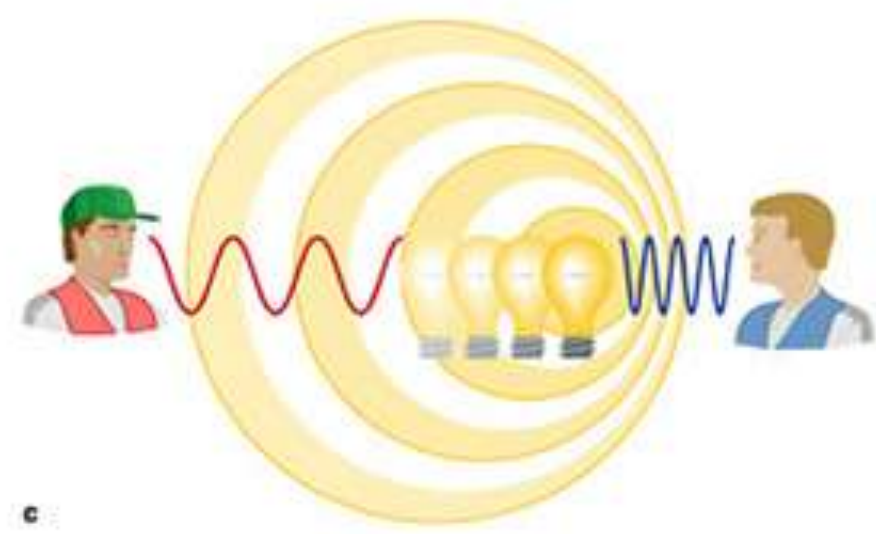
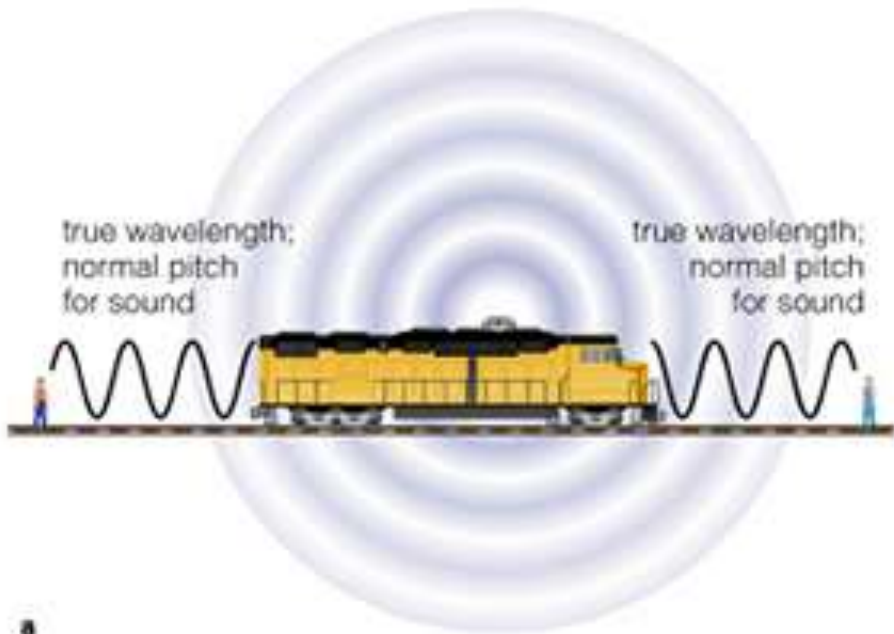
Inner ear

- **filled with fluid**

The vibration pass into the fluid which stimulate nerve impulses to send message to the brain where it is interpreted as sound

Doppler effect

- **Moving objects cause waves to be compressed and lengthened thus changing the frequency of the sound**

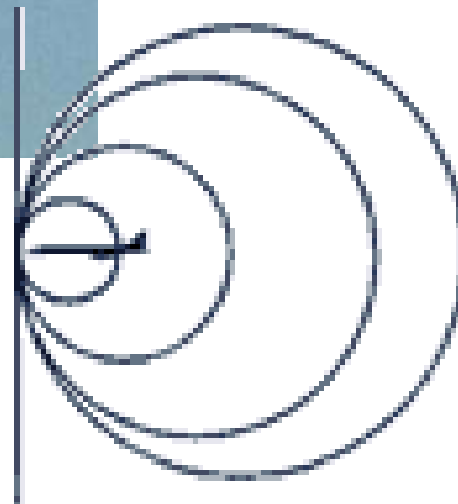


Sonic boom

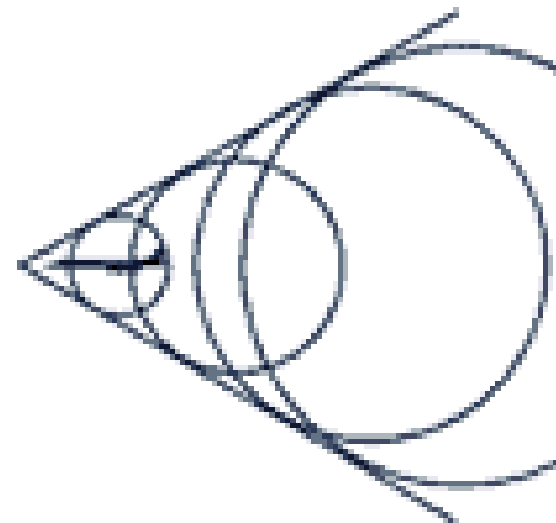
- **is caused by an object that moves faster than the speed of sound**
- **The object passes through the compressional wave causing the wave to form a wake**



**Pressure Waves
in Subsonic Flight**




**Shock Wave
at Mach One**



**Supersonic
Shock Cone**

Acoustics

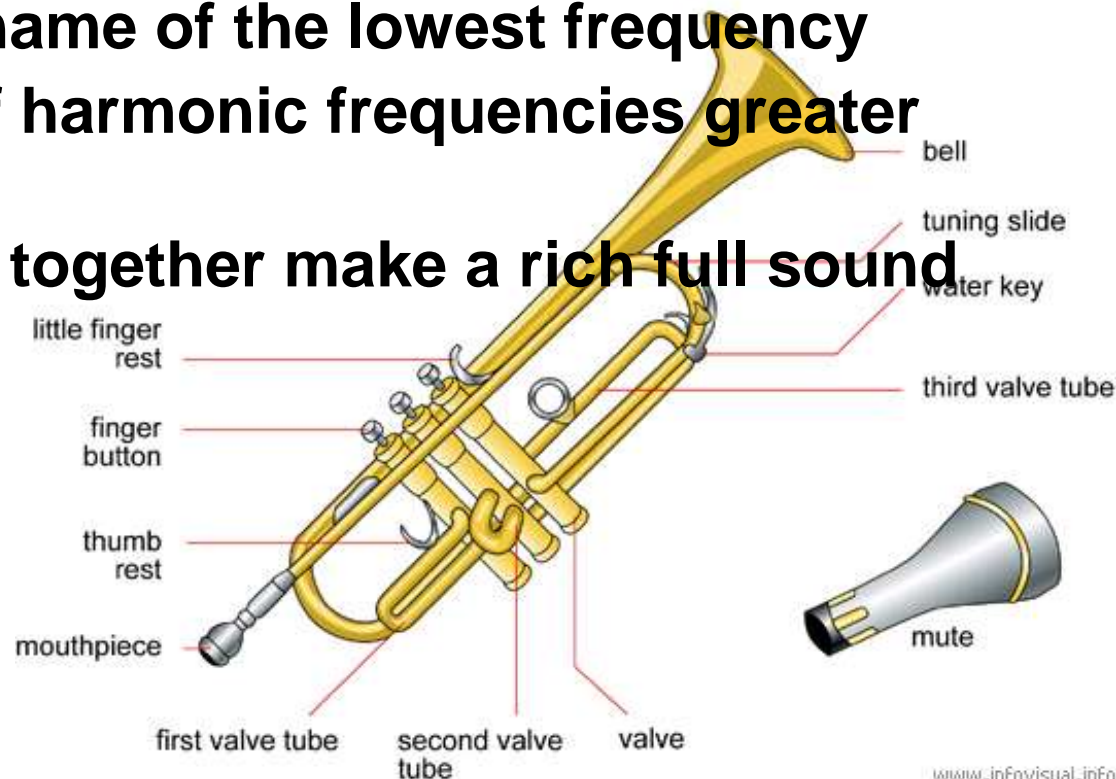
- **Transmission of sound**
In a good auditorium sound should decrease quickly and not bounce around
- **Reverberation – is the combination of many small echoes occurring very close together.**
- **When reflected sound waves meet at one point one right after the other**
- **This causes sound to take a long time to fade**
- **Seats, light fixtures, and decorations all effect acoustics of an auditorium**

Notes	Octaves O1	O2	O3	O4	O5	O6	O7	O8
A	27.500	55.000	110.000	220.000	440.000	880.000	1760.000	3520.000
B ^b	29.135	58.270	116.541	233.082	466.164	932.328	1864.655	3729.310
B	30.868	61.735	123.471	246.942	493.883	987.767	1975.533	3951.066
C	32.703	65.406	130.813	261.626	523.251	1046.502	2093.004	4186.009
C#	34.648	69.296	138.591	277.183	554.365	1108.731	2217.461	
D	36.708	73.416	146.832	293.665	587.330	1174.659	2349.318	
E ^b	38.891	77.782	155.563	311.127	622.254	1244.598	2489.016	
E	41.203	82.407	164.814	329.629	659.255	1318.520	2637.020	
F	43.654	87.307	174.614	349.228	698.456	1396.913	2793.826	
F#	46.249	92.499	184.997	369.994	739.989	1479.978	2959.955	
G	48.999	97.999	195.998	391.995	783.991	1567.982	3135.437	
G#	51.913	103.826	207.652	415.305	830.609	1661.219	3322.437	
	O1	O2	O3	O4	O5	O6	O7	

Musical Sound

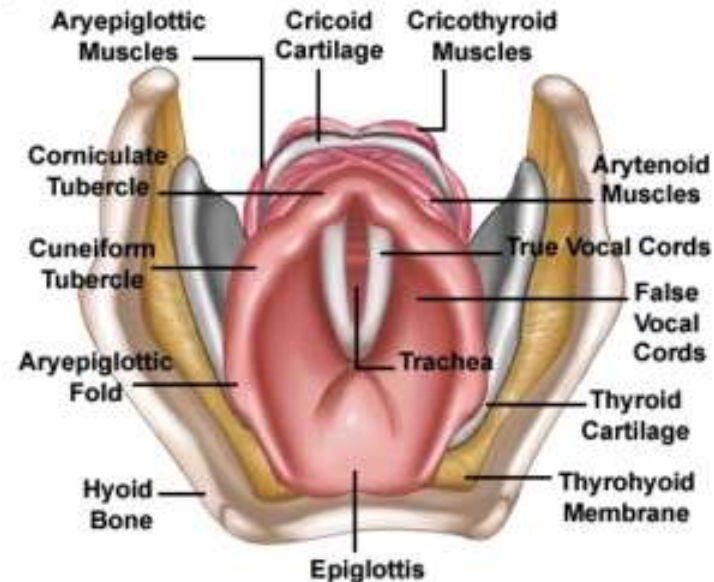
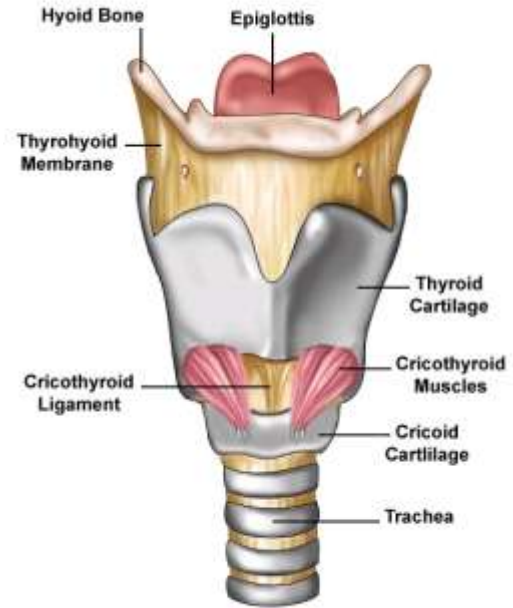
- Tone quality is the manner in which the pitch is achieved
- Harmonic series is a group of frequencies that have the ratio 1:2:3:4:5
- Pitch depends on the lowest frequency or overtone in its harmonic series
- Fundamental is the name of the lowest frequency
- Overtones – name of harmonic frequencies greater than fundamental
- The harmonic series together make a rich full sound

TRUMPET



The human voice

- **Larynx (voice box)**
 - Vocal cords – two folds of tissue
 - Pitch is constantly being changed by stretching and relaxing of the vocal cords
 - Distinct syllables are formed by the lips and tongue



Noise and Health

- **Noise is a random mixture of sound waves frequencies**
- **Hearing loss is the result of continual exposure to high noise levels**
 - Jack hammers**
 - Saws**
 - Music**
 - Engines**
 - Ear protection and things to muffle sound**

White Noise



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"I don't hear the ocean, just a bunch of white noise."