

## Production of Sound

- \* Produced by vibrations.
- \* When a tuning fork is struck, its prongs vibrate producing sound waves.
- \* Speed of the sound depends on the medium by which sound waves travel.
- \* Sound produced in humans is due to the vocal cords.

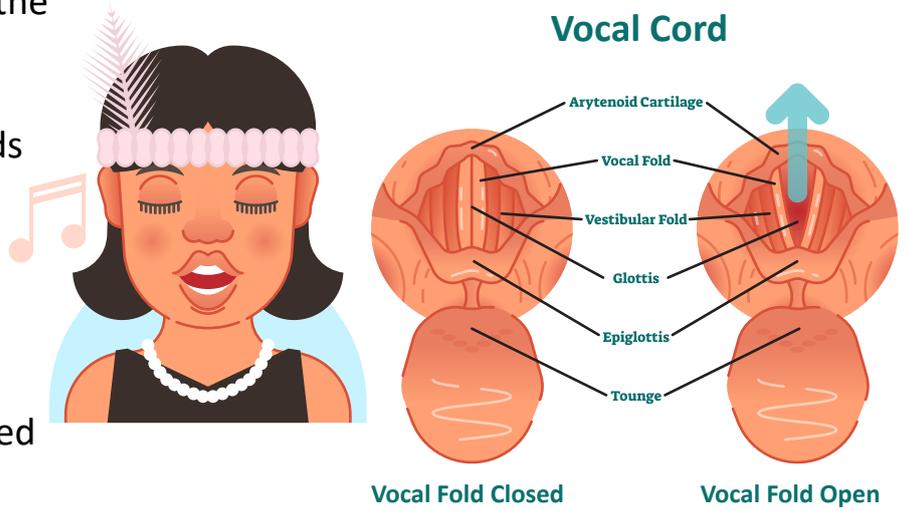


## Propagation of Sound

- \* A sound is an energy that is transmitted in the form of sound waves.
- \* When the objects vibrate, the air surrounding it vibrates and sound waves are carried.
- \* If there is no medium, then vibrations in an object will not travel through it.
- \* **Sound requires a medium to travel.**

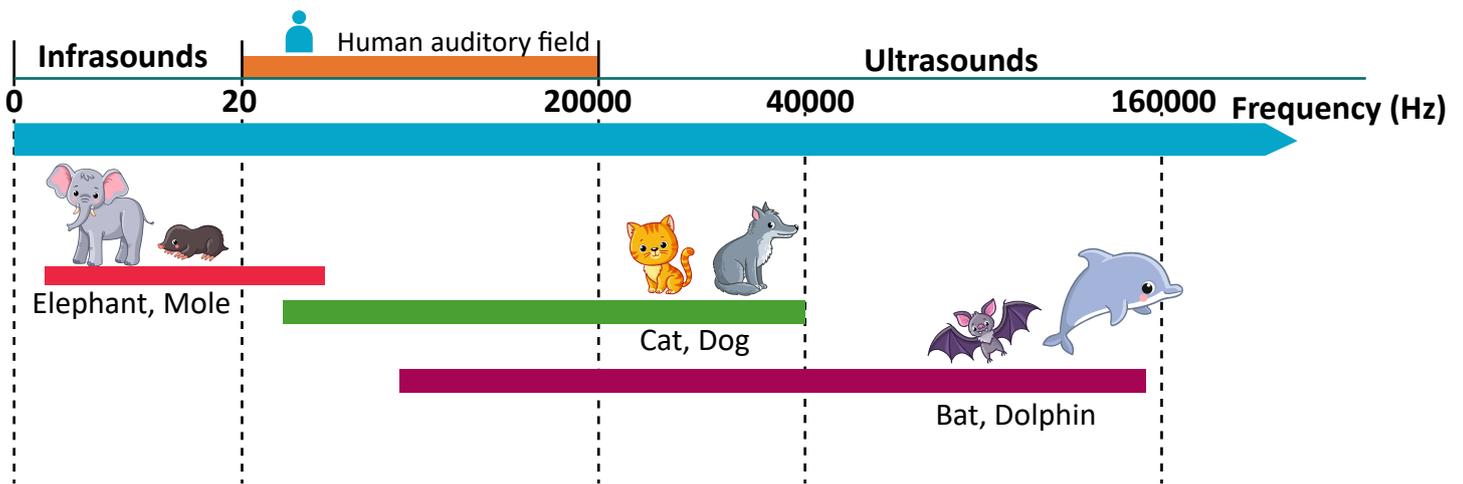
## Sound produced by humans

- \* The human voice is produced by the vocal chords.
- \* When air is blown from the lungs through the larynx, the vocal cords vibrate at a frequency and produce sound.
- \* When these sound waves pass through our mouth and tongue, its pitch and quality are changed and the sound waves are converted into understandable speaking.



## Audible and Inaudible sound

- \* The audible range of sound for human beings extends from about 20 Hz to 20000 Hz.
- \* Any sound outside this hearing range is undetected by human ears regardless of its amplitude.



## Characteristics of Sound

The characteristics of sound are as follows:

- \* Pitch
- \* Loudness
- \* Quality

### Pitch

- \* Pitch is a characteristic of sound by which a correct note can be distinguished from a grave or a flat note.
- \* Pitch depends upon the frequencies of the sound wave.
- \* A note has a higher pitch when the frequency is high and a note of low frequency has a low pitch.

### Loudness

- \* The loudness is a sensation of how strong a sound wave is at a place.
- \* Loudness increases with amplitude.
- \* Loudness is measured in **decibel (dB)**. It is given as:

$$L = \log(I), \text{ here 'I' is the intensity.}$$

### Quality

- \* Quality or timbre describes those characteristics of sound which allow the ear to distinguish sounds which have the same pitch and loudness.

## Laws of Reflection of Sound

- \* The angle of incidence is equal to the angle of reflection.
- \* Incident wave, reflected wave and normal at the point of incidence, all lie in the same plane.

## Transmission of Sound

- \* Vibration is the back and forth movement of an object.
- \* Sound waves travel in all directions.
- \* Sound energy moves as one particle hits another particle.

## Applications of Reflection of Sound



### Megaphone:

Increase the intensity of sound waves in a particular direction.



### Stethoscope:

Sound undergoes multiple reflection in the wires.



### Curved ceiling:

Evenly distribute sound across the hall.

## Speed of Sound

### In solids

Particles are very close to the other one. Hence sound travels at a very high speed.

### In Liquid

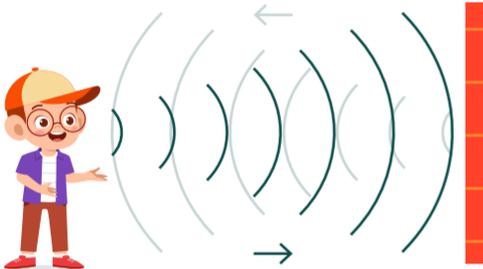
Particles are at some distance, hence sound takes more time to travel.

### In Gas

Particles are spread out, hence sound is the slowest.

## Echo

- \* Echo is the result of reflection of sound.
- \* Echo is heard after the sound is reflected back when the actual sound has stopped.

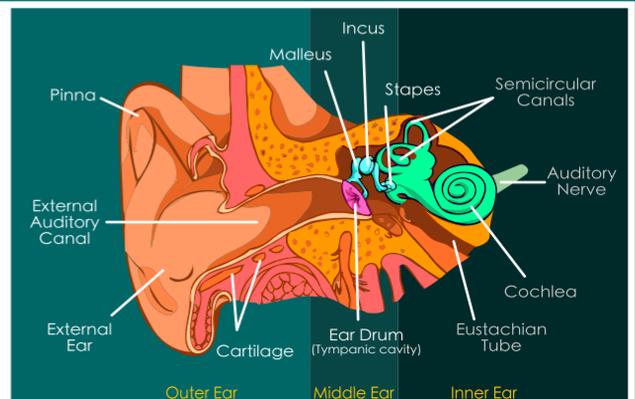


## Conditions for Echo

- \* The reflected sound must reach ear 0.1 s after the direct original sound.
- \* For echo in air, distance between the source of sound and obstacle should be at least 17.2 m. For water this value is 70 m.
- \* The reflecting surface must be rigid such as a building, hill or a cliff.

## Human Ear

- \* Ear is the human organ that enables us to hear sounds around us.
- \* The main function of the ear is to maintain our sense of balance and to detect the various sounds.
- \* It helps us to convert the pressure variations into electronic signals that travel through the brain via the auditory nerve.



## Important Parts of Ear

### The Outer Ear

- \* The outer ear is known as pinna and earlobe which is the broad part and has shell-like structure
- \* The compressions reaching the outer ear directs the sound to the canal and makes them reach the eardrum.

### The Middle Ear

- \* Hammer, the Anvil, and the Stirrup are the three bones which transmit the sound.
- \* The center part of the eardrum is connected to the hammer.
- \* The hammer vibrates and transmits the sound to the other two bones.
- \* These bones amplify the sound waves several times like about 20 times.

### The Inner Ear

- \* The inner ear known as Cochlea is a snail-like structure.
- \* Cochlea sends the sound to the brain as some amount of fluid is present inside the cochlea.
- \* These electrical impulses then go to the auditory nerve. This is exactly what we perceive as sound.

## Protection of Human Ear

- \* The audible range for human beings is about 20Hz to 20,000Hz.
- \* Sound exceeding this range remains undetected, whatever the amplitude may be.
- \* Headphones that we use are dangerous as they directly fit into our eardrums. To protect our ears, the volume should not exceed 60%.
- \* When you attend concerts step outside the concerts at least for few minutes to bring your ears to rest.
- \* Keep your ears dry once you are done bathing and swimming.