# ST. ANDREWS SCOTS SR. SEC. SCHOOL

**9th Avenue ,I.P. Extension , Patparganj , Delhi -110092**

**Class IX Sound**

## Sound

Sound is a form of energy which produces the sensation of hearing.

Sound is produced due to the vibration of objects.

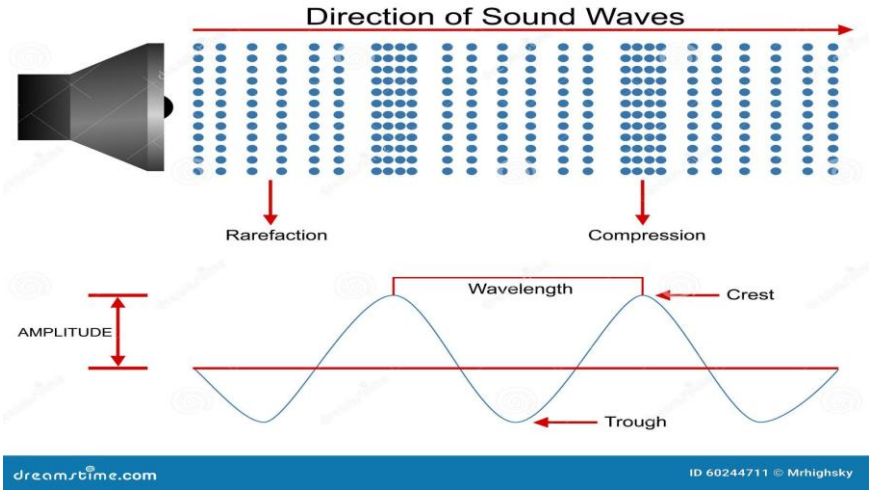
Sound needs a material medium to travel and cannot travel in vacuum.

## Production of Sound

Sound is produced when an object vibrates.

These vibrations set the particles of the surrounding medium into vibration.

The vibrating particles transfer energy to neighbouring particles and sound propagates through the medium.

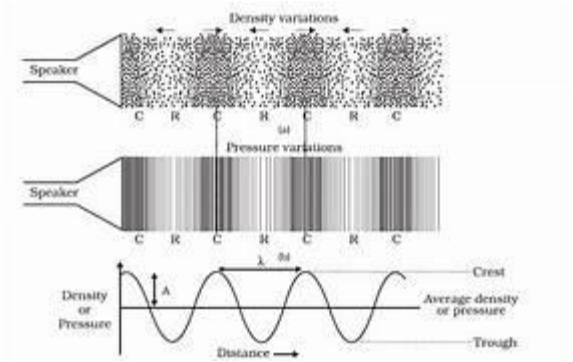



## Propagation of Sound

Sound propagates through a medium in the form of waves.

The particles of the medium do not travel with the wave but only vibrate about their mean positions.

Sound travels in solids, liquids and gases.




## Sound Waves

Sound waves are mechanical waves because they require a material medium for propagation.

Sound waves are longitudinal in nature.

**Longitudinal Waves**

A wave in which the particles of the medium vibrate back and forth in the same direction in which the wave travels is called a longitudinal wave.

Sound waves consist of alternate regions of high pressure and low pressure called compressions and rarefactions.

**Compression**

Compression is the region where particles of the medium are close together. It is the region of high pressure and high density.

**Rarefaction**

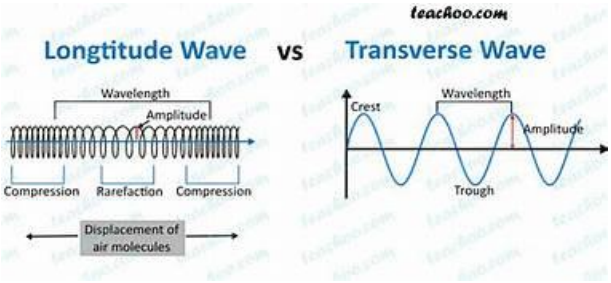
Rarefaction is the region where particles of the medium are far apart. It is the region of low pressure and low density.

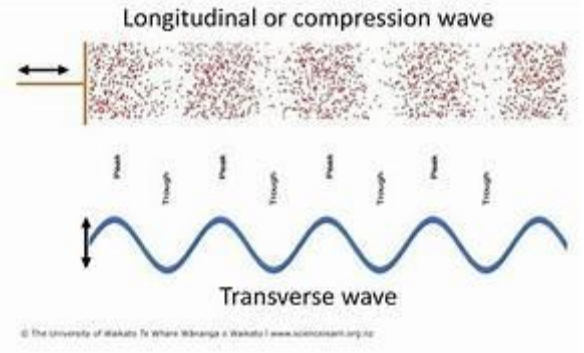
**Transverse Waves**

A wave in which the particles of the medium vibrate perpendicular to the direction of wave propagation is called a transverse wave.

Transverse waves have crests and troughs.

Sound waves do not propagate as transverse waves in air.




| Longitudinal Wave | Transverse Wave |
|---|---|
| Particles of the medium vibrate parallel to the direction of wave propagation. | Particles of the medium vibrate perpendicular to the direction of wave propagation. |
| Compressions and rarefactions are formed. | Crests and troughs are formed. |
| Can travel through solids, liquids and gases. | Can travel mainly through solids and liquids. |
| Sound waves are longitudinal in nature. | Light waves and water waves are transverse in nature. |
| Pressure and density change occurs in the medium. | No pressure and density change occurs in the medium. |

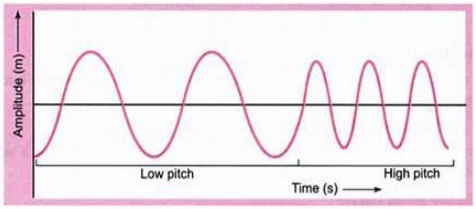
## Characteristics of Sound Waves

### Amplitude

Amplitude is the maximum displacement of the particles of the medium from their mean position.

Loudness of sound depends on amplitude.

Greater the amplitude, louder is the sound.




### Time Period

Time period is the time taken by a particle of the medium to complete one vibration.

It is measured in seconds.

### Frequency

Frequency is the number of vibrations per second.

Its SI unit is hertz (Hz).

$$\text{Frequency} = \frac{1}{\text{Time Period}}$$

Higher frequency sound has higher pitch.

### Wavelength

Wavelength is the distance between two consecutive compressions or two consecutive rarefactions.

Its SI unit is metre (m).

Speed $v = \frac{\text{Distance}}{\text{Time}}$

$v = \frac{\lambda}{T}$

Distance = wavelength of the sound wave, it is the distance travelled by the sound wave in one time period ($T$) of the wave.

$\therefore \quad v = \frac{\lambda}{T} \qquad \left(as\ v = \frac{1}{T}\right)$

$\therefore \quad v = \lambda v, \quad \text{Frequency} = \frac{1}{\text{Time period}}$

Speed = Wavelength × Frequency.

### Speed of Sound

Speed of sound is the distance travelled by sound per unit time.

$$v = f\lambda$$

Speed of sound is maximum in solids, less in liquids and minimum in gases.

**Audible and Inaudible Sounds**

Sounds having frequency between 20 Hz and 20,000 Hz are audible to humans.

**Infrasonic Sound**

Sounds having frequency less than 20 Hz are called infrasonic sounds.

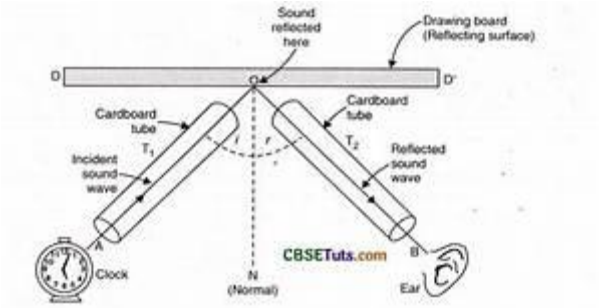
**Ultrasonic Sound**

Sounds having frequency greater than 20,000 Hz are called ultrasonic sounds.

**Reflection of Sound**

Sound waves obey the laws of reflection.

The direction in which the sound is incident and the direction in which it is reflected make equal angles with the normal.




Reflection of sound. The angle of reflection of sound ($r$) is equal to the angle of incidence of sound ($i$).

**Echo**

The repetition of sound caused by reflection of sound waves is called echo.

For hearing an echo, the minimum distance between the source of sound and reflecting surface should be 17.2 m.

**Reverberation**

The persistence of sound due to multiple reflections in an enclosed space is called reverberation.

Excessive reverberation causes noise pollution.

**Uses of Ultrasound**

Ultrasound is used in medical diagnosis.

It is used to detect cracks and flaws in metal blocks.

It is used in SONAR.