

# SOUND CLASS 8

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**WHAT DOES A SOUND DO ? It helps us to communicate.**

## HOW IS SOUND PRODUCED?

1) Sound is a form of energy which is produced due to the vibrations of a body moving in to and fro (back or forth) motion of a body

2) What is Vibration?

A vibration is a periodic to and fro motion. That is any motion that takes place at periodic intervals of time.

When a pendulum moves, it moves from one end to the other end at equal intervals of time. The time taken from the middle pt to the extreme right is equal to the time taken from the middle pt to the left side.

Now this motion is also called oscillatory motion. And when these oscillations take place faster then they are called vibrations.

e.g. pendulum in a clock is oscillation while

guitar strings vibrate very fast. So they are vibrating.

3). We humans have a Larynx or voice box. It is located in the throat and is located at the upper end of the wind pipe/trachea. The larynx has vocal cords which expand and contract to allow air to move in and out and produces sound.

4). Sound is also produced by vibrations in strings, vibrations in stretched skins or membranes & also by vibrations in air columns and water.

5). PROPOGATION OF SOUND- It needs a medium to propagate. (i.e. it needs particles for it to be transferred).

-Hence it is a mechanical wave unlike an Electromagnetic waves that do not need a medium(e.g. Radio **waves**, Light **waves**, thermal **radiation**, X ray, visible light, microwave, infrared rays).

-It can therefore travel through solids, liquids and air but cannot travel through vacuum

- It travels fastest in solids, followed by liquids and then gases

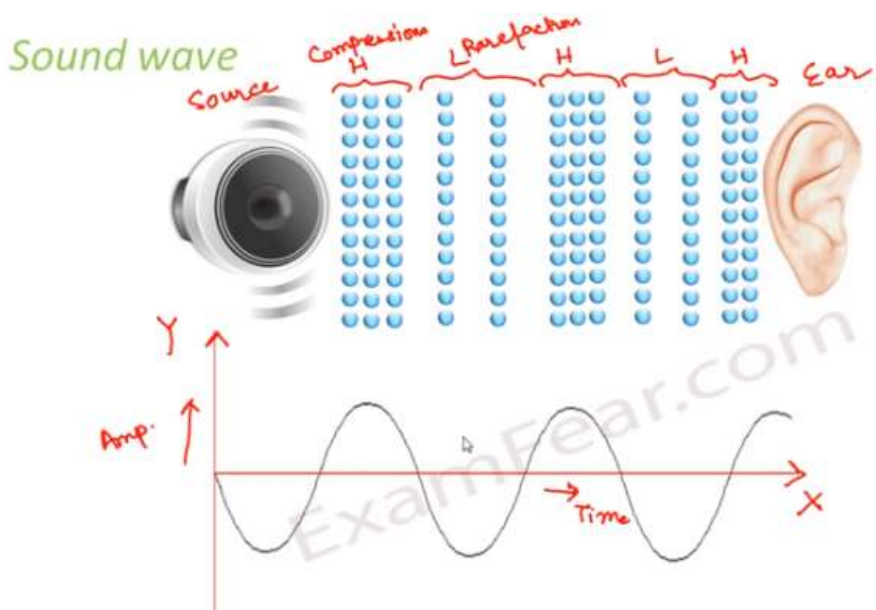
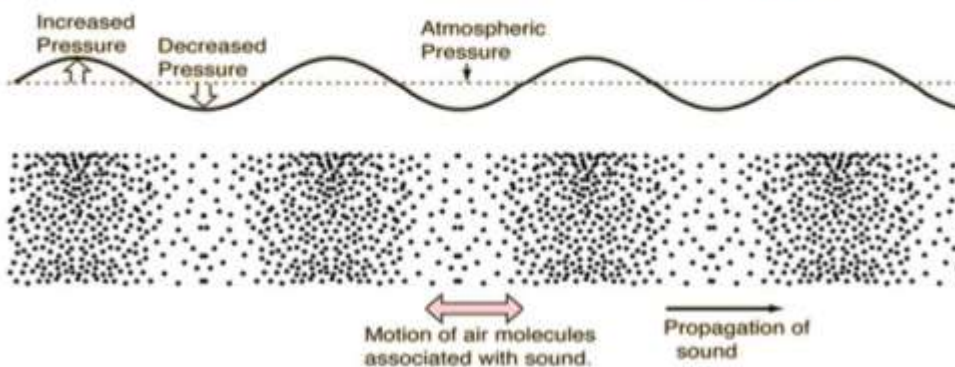
- It is expressed in decibels (db).

- Zero decibel sound means pin drop silence.

6). Sound travels (propagates) in the form of a wave of vibrations which moves away from the source.

But first lets again see how a sound wave travels...the disturbance makes the particles vibrate.

- **Sound waves are longitudinal waves:**
- **longitudinal wave the particle displacement is parallel to the direction of wave propagation.**



When the particles become denser it's called compression and when they become less it's called rarefaction.

## WHY SOUND VARIES??

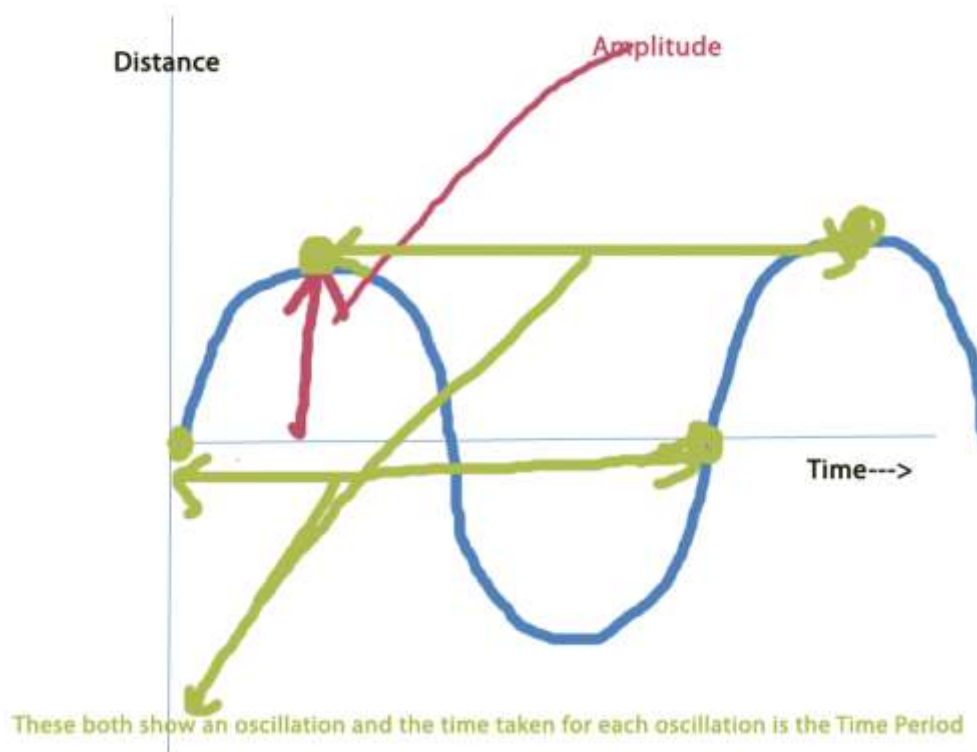
Now how does a sound vary? It varies due to various parameters that it has like wavelength, frequency, time period, pitch, amplitude, speed, quality etc.

⇒ The maximum distance moved by the particle of the medium on either side of the mean position represents the **AMPLITUDE**

⇒ Amplitude determines the loudness or softness of a sound. It thus depends on the amount of force which is being applied. Eg. When you tap a desk gently vs. with greater force ...more force means more vibration and hence louder noise.

So let us see how an amplitude looks on a graph

⇒ The time taken by a particle of the medium to complete one vibration (oscillation) is called the **TIME PERIOD**. It is expressed in seconds.



Now if we start counting how many times does a pendulum oscillated in say 1 second.  
Then it might be doing 2 oscillations in 1 second.

When it moves faster then maybe it is able to complete 5 oscillations in 1 second.

➡ The no of oscillations per second is called the **FREQUENCY**. It is measured in Hertz(HZ).

(i.e. Frequency is defined as the no. of whole wavelengths (or complete oscillations )that pass a given point per second)

So if a pendulum makes 5 oscillations in 1 second, the frequency is said to be 5 hertz.

- So frequency of 50 Hz represents 50 oscillations in 1 second.
- An increase in frequency means more vibrations or oscillation in a given time.

NOTE: Frequency determines the shrillness or pitch of a sound.

High Frequency → sound is shrill & at a higher pitch (e.g. whistle high freq.) पतली

Low Frequency → sound has a lower pitch. (E.g. Drum has low freq. & produces a low pitched sound). गहरा whereas amplitude is loud vs halki/soft aawaz

Example: Bird = makes a high pitched sound.

Lion = makes a low pitched roar. But a lion can also have a loud (high amplitude voice when he screams)

$FREQUENCY = 1/Time\ Period$

This is because  $T =$  Time taken for 1 oscillation

$F =$  How many oscillations in 1 second will be  $1/T$

Let's observe the figures below to see how time period and frequencies change:

Fig 1 shows. 1 oscillation in 1 second. This means the time period is 1 second and the frequency is 1 Hertz.

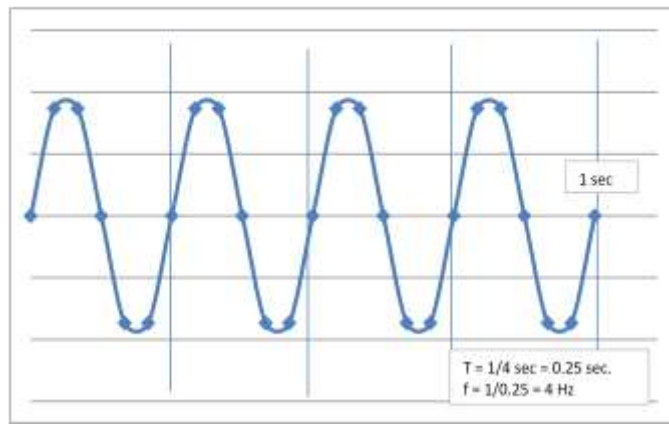
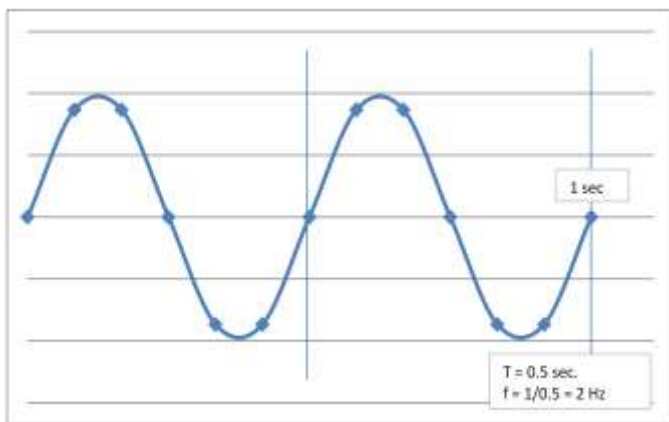
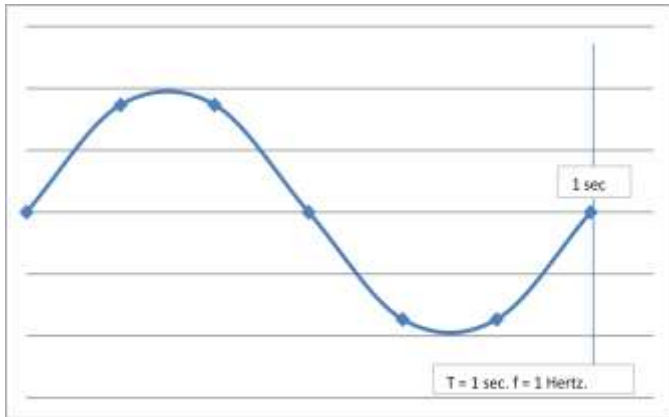


Figure 2 shows 2 oscillations in 1 second. This means the frequency is 2 hertz. The time period is therefore calculated by  $F=1/T$ . So  $2=1/T$ . Therefore  $T=1/2=0.5$  seconds

Figure 3 shows 4 oscillations in 1 second. This means the frequency is 4 hertz. The time period is therefore calculated by  $F=1/T$ . So  $4=1/T$ . Therefore  $T=1/4=0.25$  seconds

## CHARACTERISTICS OF SOUND

Sound are generally characterized by – **loudness, pitch & quality (timbre)**

### **LOUDNESS:**

1. Loudness of a sound depends on its amplitude.

∴ Larger the amplitude louder will be the sound.

### **PITCH:**

It is the type of sound produced due to the frequency or the degree of height or depth of a sound due to its frequency is called pitch.

So, frequency of the sound determines whether an object has a high pitch or a low pitch.

- A high frequency sound will have high pitch & therefore will be shriller. E.g. A bird chirps at a high frequency & hence makes a shrill sound.
- A low frequency sound will be low pitched & hence less shrill.

E.g.

A sound of a male is diff from the sound of a female. This is because the female voice has a higher pitch. i.e. it is covering too many wave lengths in a period of time

### **TIMBRE (QUALITY)**

- Timbre refers to auditory sensations produced by the tone of a sound wave. i.e. refers to the quality of a sound that distinguishes it from other sounds of which have the same pitch & loudness.
- Timbre is a general term used for distinguishable characteristics of a tone.

## **AUDIBLE & INAUDIBLE SOUND**

- 1) Humans can detect sounds that have frequencies ranging from 20 Hz to 20,000 Hz.
- 2) If frequency of a sound is between 20 Hz to 20,000 Hz, the sound is said to be audible.
- 3) If frequency of a sound is below 20 Hz or above 20,000 Hz, it is said to be inaudible.
- 4) Any sound with frequency less than the audible range of hearing (ie. 20 Hz) is called infrasonic sound / infrasound. Animals like whales, elephants, pigeons etc.
- 5) A sound with frequency above the audible range of hearing (ie. > 20,000 Hz) is known as ultrasonic sound /ultrasound. Eg. Dogs, cows, bats etc.

Audible range of frequencies of some animals is:-

Dogs → 50 Hz to 45,000 Hz

Cats → 45 Hz to 85,000 Hz

Bats → upto 1,20,000 Hz

Dolphins → upto 2,00,000 Hz

Elephants → 5 Hz to 10,000 Hz

NOTE: Whales & Dolphins have high sound frequencies and can communicate with one another even at long distances since sound also travel faster in water than in air.

## **MUSIC**

Sounds those are pleasant to hear. Certain musical instruments like sitar, flute etc produce a sound that is pleasing to hear.

## **NOISE**

Sound which is unpleasant (may be produced by musical instruments) unwanted acts by humans (like honking vehicles, screaming), machines etc. is called Noise.

## **MEASURING NOISE**

- 1) Sound / Noise is measured /expressed in decibels (db).
- 2) Zero on a decibel scale is threshold of hearing.  
i.e.
  - 0 db = threshold of hearing
  - 20 db = whisper
  - 40 db = noise in a quiet office
  - 60 db = normal conversation
  - 80 db = level at which sound becomes physically painful

## **NOISE POLLUTION**

The presence of excessive & unwanted noise in the environment creates a condition called the noise pollution.

Source :

- Road, air, rail traffic
- Neighborhood noise e.g. Loudspeakers, fire crackers etc.
- Noise from industries

Effects:

- Hearing impairment
- Nervous tensions & high blood pressure
- Headaches, sleeping disturbances

Control:

- Locating noise producing units / factories away from residential areas.
- Restricting the use / time of loudspeakers etc. in localities.
- Restriction on honking.
- Using silencers in mopeds and cars etc.