Sound

- Vibrating body produces sound.
- Vibration motion– to-and-fro or back-and-forth or up-and-down motion of a body.
- Sound is a form of energy that is produced by producing vibration in an object.
- Sound cannot move through vacuum; sound waves are longitudinal waves.

- Sound requires **material medium** for propagation.
- Sound can travel through solid, liquid or gas.
- Sound cannot travel through vacuum.
- No sound can be heard in outer spaces.

- Sound is a form of energy that is produced by producing vibrations in an object.

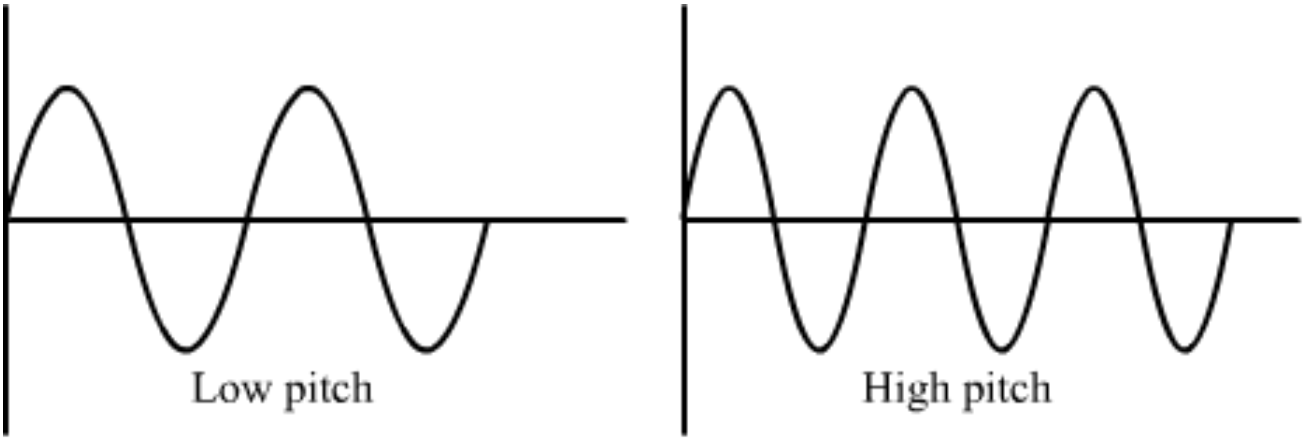
- Sound cannot move through vacuum.

- Sound is a wave that requires a medium for its propagation. The medium particles vibrate only to and fro. They do not move with the sound.

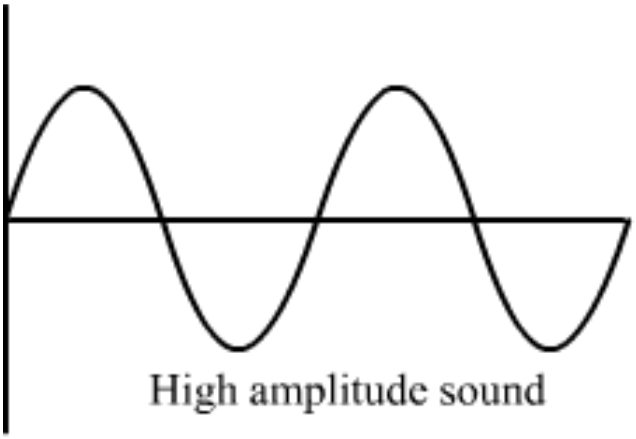
- **Characteristics of sound waves**

- **Amplitude –** Magnitude of maximum displacement from mean position
- **Wavelength (λ)** – Distance between two consecutive compressions or two consecutive rarefactions
- **Frequency (Unit - Hertz, Hz)** – Number of oscillations per unit time
- **Time period** – Time taken by two consecutive compressions or rarefactions to cross a fixed point
    - Frequency = 1Time period

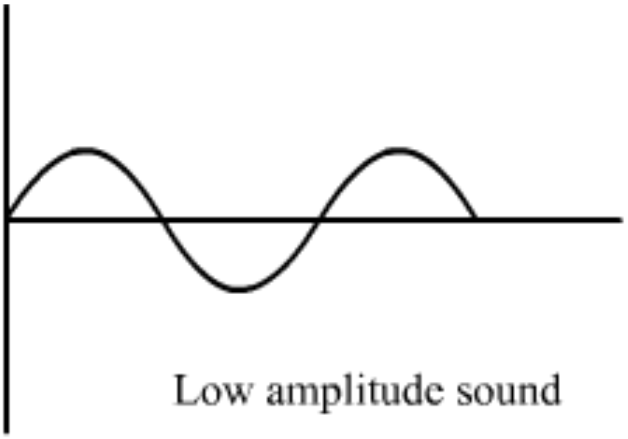
- **Pitch** – Higher the frequency, higher the pitch



- **Loudness** – Determined by amplitude



High amplitude sound



Low amplitude sound

- **Tone** – Sound of a single frequency
- **Quality or timbre**

Differentiate between two sounds of same pitch and loudness

- If the notes produce an unpleasant sound in the ear, then it is a **dischord** or **dissonance**.
- **Harmony -** Harmony is the pleasant effect produced due to concord, when two or more notes are sounded together.
- **Melody** - Melody is the pleasant effect produced by two or more notes when they are sounded one after another.
- **Musical intervals** - Musical interval is the ratio of frequencies of two notes in the musical scale.
- **Musical scale** - Musical scale is the series of notes separated by a fixed musical interval. Keynote is the starting note of a musical scale.
- **Diatonic** scale
- When two notes are sounded simultaneously and produce pleasant sensation in the ear, then it is **concord** or **consonance**.
- It contains series of eight notes.

- **Octave** is the interval between the keynote and the last tone.
- **Advantages of a diatonic scale**
    - This scale provides the same order and the duration of chords and intervals, which succeed each other, that are required for a musical effect.
    - This scale can produce musical compositions with the lower and higher multiples of frequencies of the notes.

Speed of sound

- Speed of sound $v = \nu \times \lambda$
- Speed in solid > Speed in liquid > Speed in gas
- Speed depends on temperature, pressure, humidity and nature of the material of the medium.
- Speed increases with increasing temperature.
- In air, speed of sound is 344 m s^{-1} at 22 °C
- Supersonic – The rate of distance travelled by the object is more than the speed of sound.
- Sonic boom - loud noise produced by supersonic object is sonic boom

Loudness is the characteristic of sound by virtue of which a loud sound can be distinguished from a feeble one, both having the same pitch and timbre. It depends upon the amplitude of the wave. The unit of loudness is phon and decibel (dB).

Loudness of sound

- is directly proportional to the square of amplitude
- inversely varies with the square of distance from the source
- is directly proportional to the surface area of vibrating body
- is directly proportional on the density of the medium

- increases with the presence of resonating bodies near the vibrating body

Intensity of sound

It is the amount of sound energy passing per second normally through the unit area around a point in a medium. Its unit is watt per meter^2 .

The intensity of sound wave is proportional to

- square of the amplitude of vibration
- square of the frequency of vibration
- density of air

Relationship between loudness and Intensity

According to Weber and Fechner, the relationship between loudness and intensity is $\boldsymbol{L = K \log_{10} I}$. Here, K is the constant of proportionality.

Noise pollution

Noise pollution is the disturbance produced by noise which has harmful impact on humans and animals. When sounds of level above 120 dB is produced from various sources such as loudspeakers, moving vehicles etc., then such sounds are reffered as noise.

- **Musical instruments and their vibrating parts**

Musical instrument	Vibrating part producing sound
Veena	Stretched string
Tabla	Stretched membrane
Flute	Air column