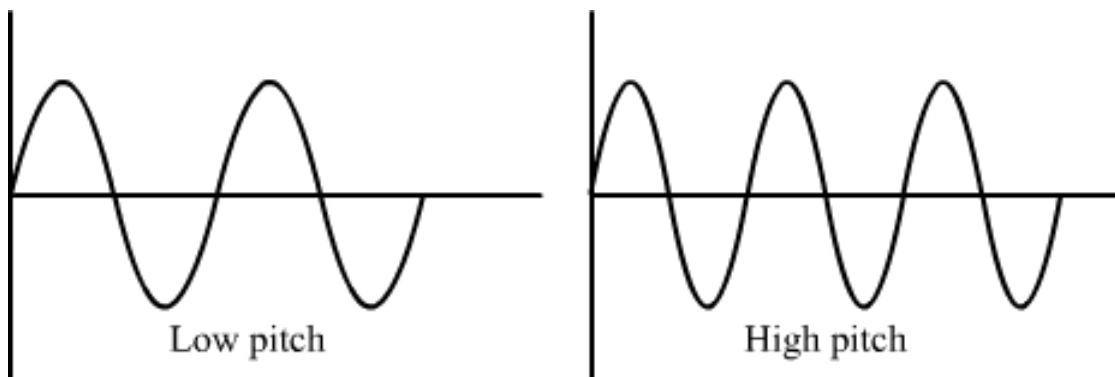


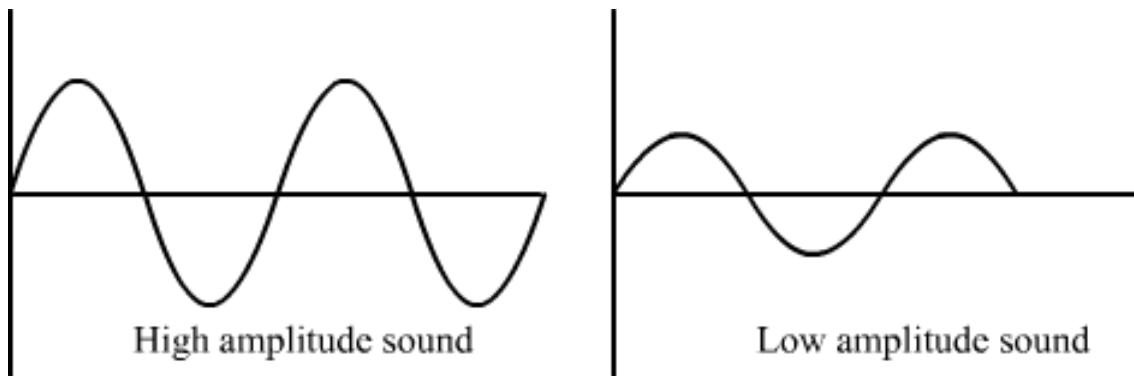
Sound

- 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.
- In humans, sound is produced by **voice box** or **larynx**.
- When the lungs force air through the slit, the vocal cord vibrates and produce sound.
- The muscles attached to the vocal cords can make the cords tight or loose to produce different types of sounds.
- Different people have different vocal chords. Due to this reason, we all have a different voice quality.
- 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.
- **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 = $1/\text{Time period}$

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



- **Loudness** – Determined by amplitude



- **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 $v = v \times \lambda$
- 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
- **Range of hearing for humans:** $20 - 20000 \text{ Hz}$
- Rhinoceroses use infrasound ($<20\text{Hz}$) and bats use ultrasound ($>20000\text{Hz}$)
- **Hearing Aid**

It is a device that amplifies sound and enables hearing impaired hear. It consists of a microphone, an amplifier, and a speaker.

- **Laws of reflections of sound:**

- (i) The incident sound, the reflected sound, and the normal to the screen at the point of incidence – all lie in the same plane.
- (ii) The angle of reflection of sound is always equal to the angle of incidence.

- **Echo**

- Reflection of sound
- Sensation of sound persists $\frac{1}{10} = 0.1\text{s}$ in the human brain
- Minimum distance to hear echo

$$\frac{344 \times 0.1}{2} = 17.2 \text{ m}$$

- **Reverberation**

- Persistence of sound by repeated reflection

- **Use of Reflection of Sound** – Loud speaker, stethoscope, curved ceiling of a concert hall, soundboard in a big hall

- Curved board or walls are used in concert halls and the speaker or the source of sound is placed at the focus of the curved wall so that sound gets reflected evenly from the wall to the audience.