🔷 What is Sound?

🟦 **Definition:**
Sound is a form of energy that causes the sensation of hearing. It is produced by vibrating objects.

✅ Example: Clapping, ringing bells, speaking, machine noises.

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🔷 11.1 Production of Sound

🟦 Sound is produced when an object vibrates.
Vibration means to and fro or back-and-forth motion.

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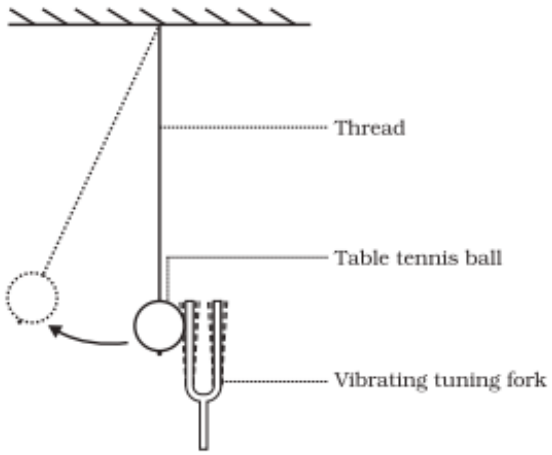
🔬 Activity 11.1

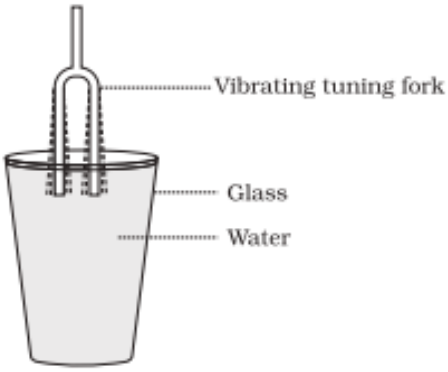
- Strike tuning fork and bring it near ear → hear sound
- Touch tuning fork → feel vibration
- Bring vibrating fork near suspended table-tennis ball → ball gets pushed → vibration detected



📷 *Fig. 11.1 – Tuning fork touching ball*

🔬 Activity 11.2

- Touch water surface with tuning fork → ripples seen
- Dip tuning fork → water splashes



📷 *Fig. 11.2, 11.3 – Tuning fork in water*

🟦 **Conclusion:** Sound is always produced due to vibration.

🔬 **Activity 11.3**
List musical instruments and note which part vibrates → strings, membranes, air columns

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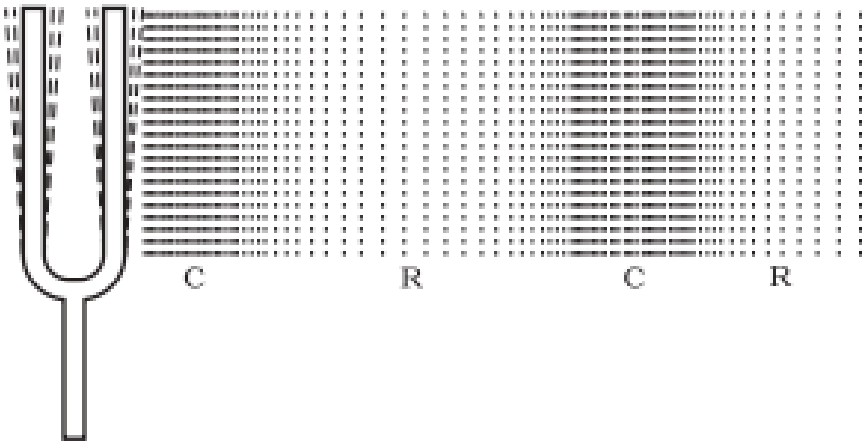
🔹 11.2 Propagation of Sound

🟦 Medium:
Substance (solid, liquid, gas) through which sound travels.

🟦 Sound needs a medium to travel. It cannot travel in vacuum.

🟦 Sound travels as a wave — disturbance travels, not the particles.

🟦 **Compression:** High pressure region
🟦 **Rarefaction:** Low pressure region



📷 *Fig. 11.4 – Compression (C) and Rarefaction (R)*

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🔹 11.2.1 Sound Waves are Longitudinal

🟦 **Longitudinal Wave:**
The particles of the medium vibrate parallel to the direction of wave.

🔬 **Activity 11.4**

- Stretch a slinky, push one end
  → observe compression moves
  📷 Fig. 11.5 – Longitudinal waves

🟦 **Transverse Waves:**
Particles move up-down, perpendicular to wave (e.g. water waves)

🟦 Sound = Longitudinal, Mechanical wave (needs medium)

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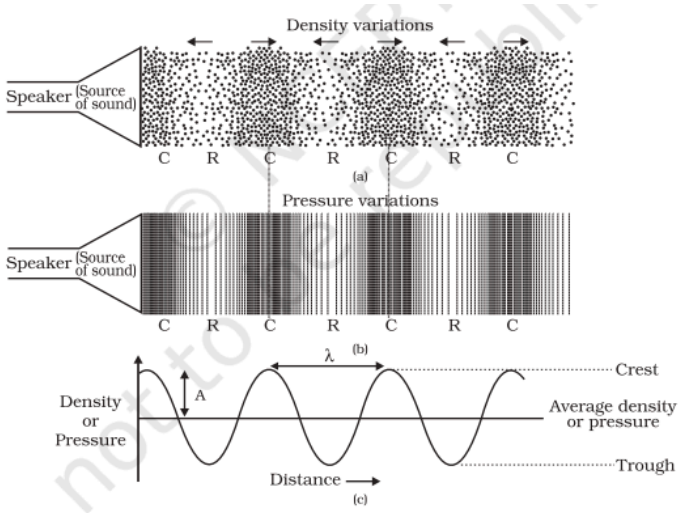
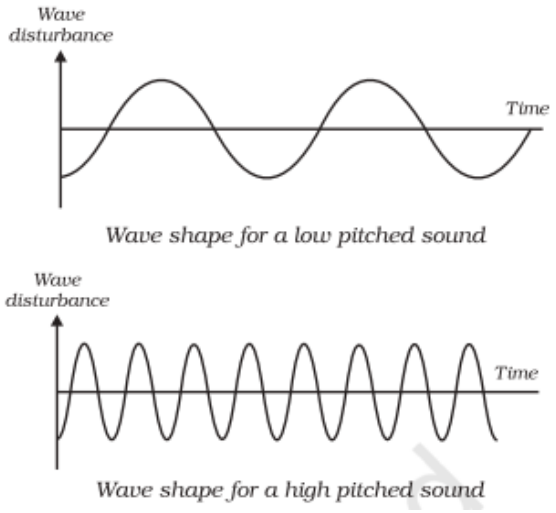
🔹 11.2.2 Characteristics of Sound Waves

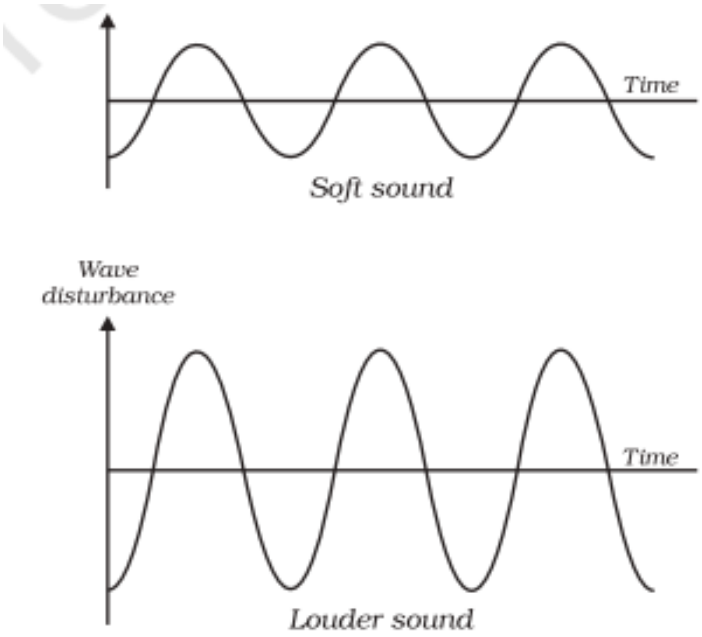
1. 🟦 **Amplitude (A):**
   Maximum disturbance on either side of mean position
   ➡ Related to loudness
2. 🟦 **Frequency (ν):**
   No. of oscillations per second
   Unit: hertz (Hz)
   ➡ Related to pitch
3. 🟦 **Time Period (T):**
   Time taken for one complete cycle
   $T = 1/\nu$
4. 🟦 **Wavelength (λ):**
   Distance between two compressions/rarefactions
   Unit: metre (m)
5. 🟦 **Speed (v):**
   $v = \lambda \times \nu$



📷 *Fig. 11.6(a, b, c) – Graph of sound wave*



📷 *Fig. 11.7 – Pitch comparison*



📷 *Fig. 11.8 – Loudness comparison*

🟦 Loudness ∝ Amplitude
🟦 Pitch ∝ Frequency

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🧠 **Quick Concepts:**

- Soft sound = Low amplitude
- High-pitched sound = High frequency
- Same speed in same medium regardless of frequency

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🔹 11.2.3 Speed of Sound in Different Media

🟦 Sound travels fastest in solids > liquids > gases

🟦 Speed in air (25°C) = 346 m/s
🟦 Speed in water = ~1500 m/s
🟦 Speed in iron = ~5950 m/s

🟦 Table: Speed in different materials (Aluminium = 6420 m/s, Sea water = 1531 m/s)

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🔹 11.3 Reflection of Sound

🟦 Like light, sound reflects from solid/liquid surfaces and follows laws of reflection.

- Angle of incidence = Angle of reflection
- Incident ray, reflected ray & normal lie in same plane

🔬 **Activity 11.5**
Use two tubes and a clock → adjust for best sound

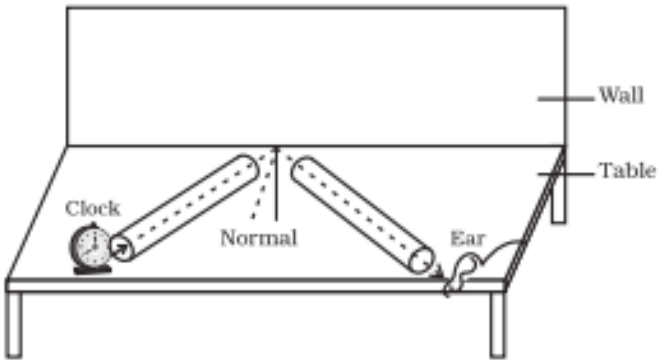

Fig. 11.9: Reflection of sound

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🔹 11.3.1 Echo

🟦 Echo:
Reflected sound heard after a delay of at least 0.1 s

🧮 Min. distance for echo = 17.2 m (when speed of sound = 344 m/s)

🟦 Multiple echoes cause thunder or repeated claps

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🔹 11.3.2 Reverberation

🟦 Reverberation:
Prolonged sound due to multiple reflections

✅ Controlled by:

- Sound-absorbing materials (curtains, carpets, false ceilings)
  📷 Fig. 11.12 – Curved ceiling

📷 Fig. 11.13 – Sound board

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🔹 11.3.3 Uses of Reflection of Sound

🟦 Used in:

- Megaphones, horns
- Stethoscopes
- Auditorium design (curved walls/ceilings)

📷 Fig. 11.10 – Megaphone

Fig. 11.11: Stethoscope

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🔹 11.4 Range of Hearing

🟦 Audible Range: 20 Hz – 20,000 Hz

- < 20 Hz → Infrasound
- 20,000 Hz → Ultrasound

✅ Examples:

- Elephants, whales → infrasound
- Bats, dolphins → ultrasound

🟦 Humans hear up to ~20 kHz, children more

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🔹 11.5 Applications of Ultrasound

✅ Used in:

1. Cleaning: Odd shapes, tubes (ultrasound shakes off dirt)
2. Detecting cracks in metal blocks

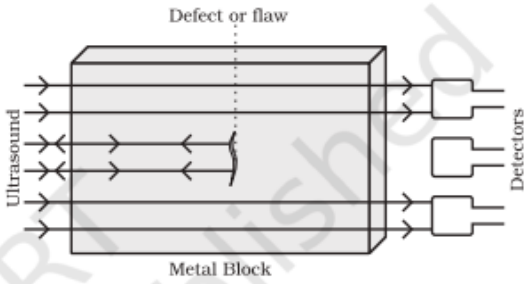

Fig 11.14: Ultrasound is reflected back from the defective locations inside a metal block.

1. Echocardiography: Image of heart
2. Ultrasonography: Image of body organs
3. Pregnancy scanning
4. Breaking kidney stones
5. Hearing Aids: Sound → electrical → amplify → ear

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📚 Summary – What You Have Learnt

- Sound is produced by vibrations
- Sound needs a medium to travel
- It travels as longitudinal waves via compressions & rarefactions
- Amplitude → loudness, Frequency → pitch
- Echoes need min. 0.1 s delay
- Sound speed: solid > liquid > gas
- Ultrasound is used in medicine and industry