

SOUND

CHAPTER 12

Class 9th



INDEX

1. Introduction : Sound-Production and Propagation
2. Medium
3. Wave and its Types
4. Characteristics of Sound
5. Audible Frequency
6. Reflection of Sound and its Laws
7. Applications of Reflection of Sound



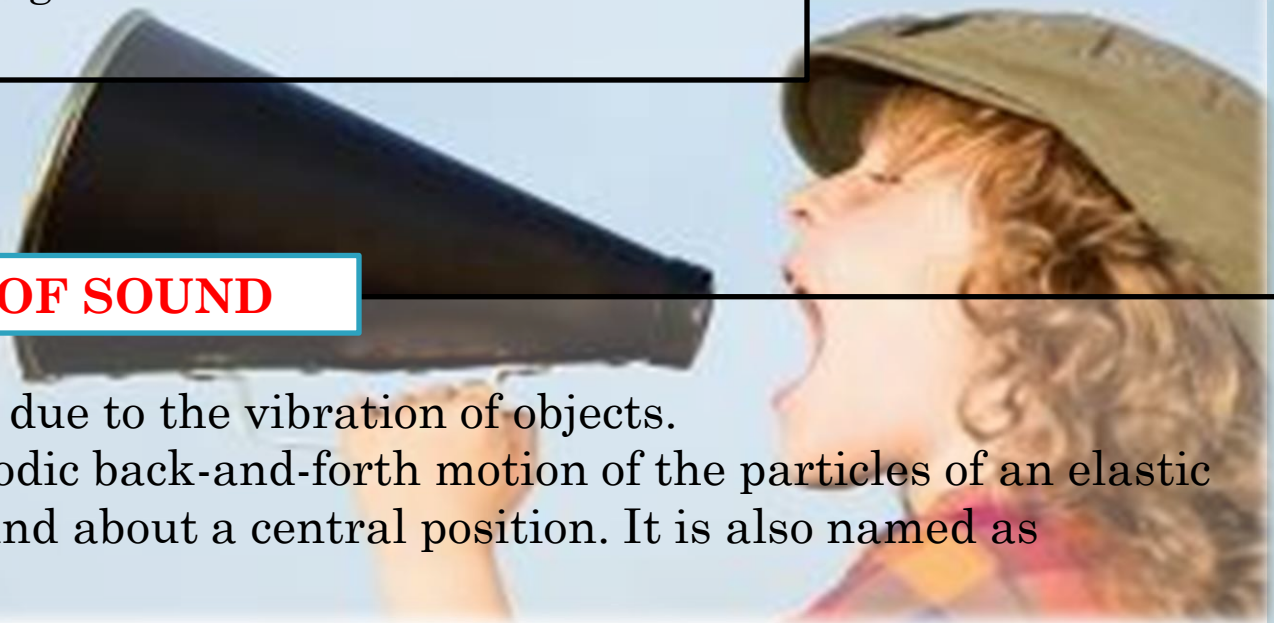
1. INTRODUCTION

SOUND

- Sound is a form of energy which produces a sensation of hearing in our ears.

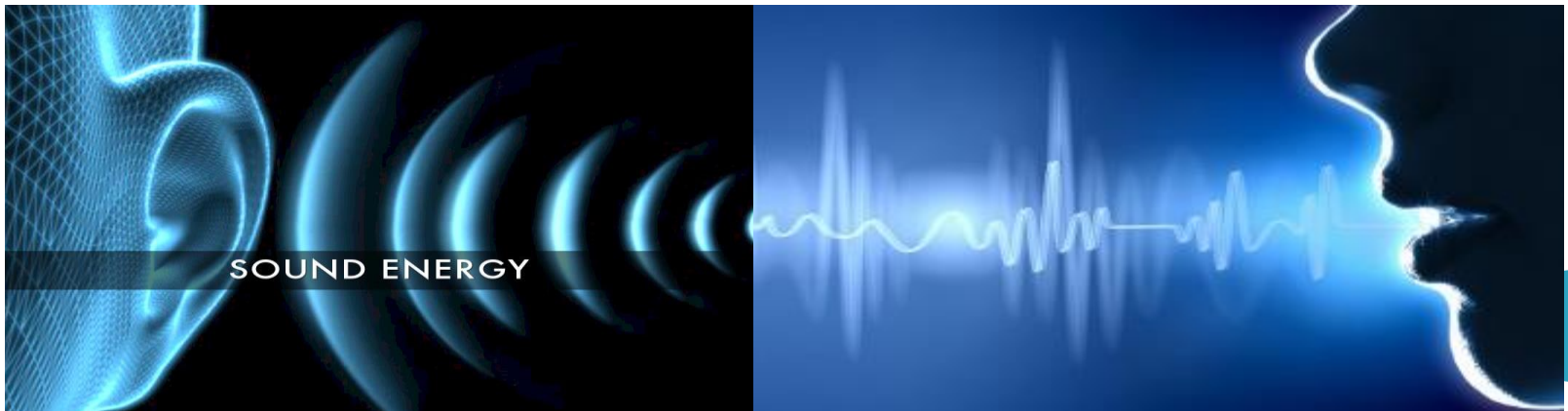
PRODUCTION OF SOUND

- Sound is produced due to the vibration of objects. Vibration is a periodic back-and-forth motion of the particles of an elastic body or medium kind about a central position. It is also named as oscillation.
For example:
- Stretched strings of a guitar vibrate to produce sound.
- When membrane of a table is struck, it vibrates to produce sound is a form of energy which produces a sensation of hearing in our ears.



PROPAGATION OF SOUND

- The travelling of sound is called propagation of sound.
- Sound is propagated by the to and fro motion of particles of the medium.
- When an object vibrates, the particles around the medium vibrate. The particle in contact with the vibrating object is first displaced from its equilibrium position. Each particle disturbs the other particle in contact. Thus, the disturbance is carried from the source to the listener.



- Only the disturbance produced by the vibrating body travels through the medium but the particles do not move forward themselves.

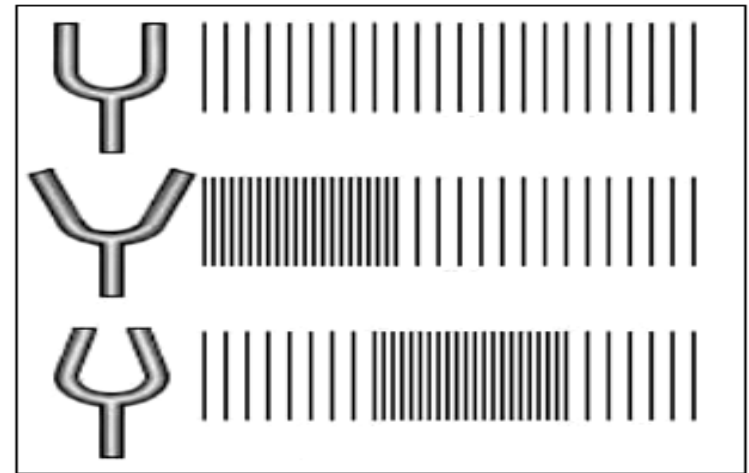
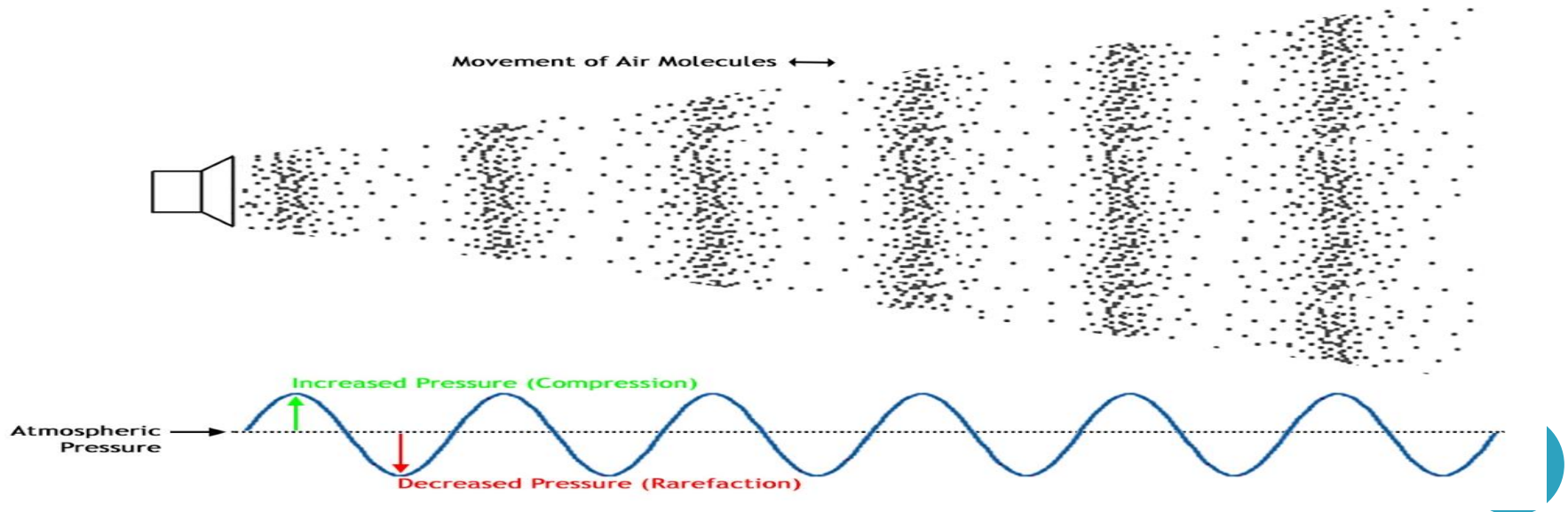


Fig. Representation of particle disturbance moving forward

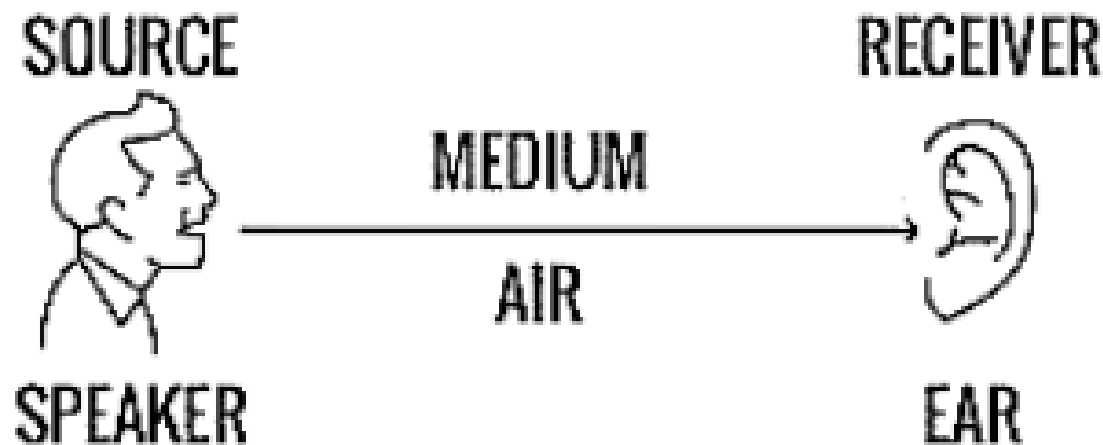
Figure 1

Sound Propagation



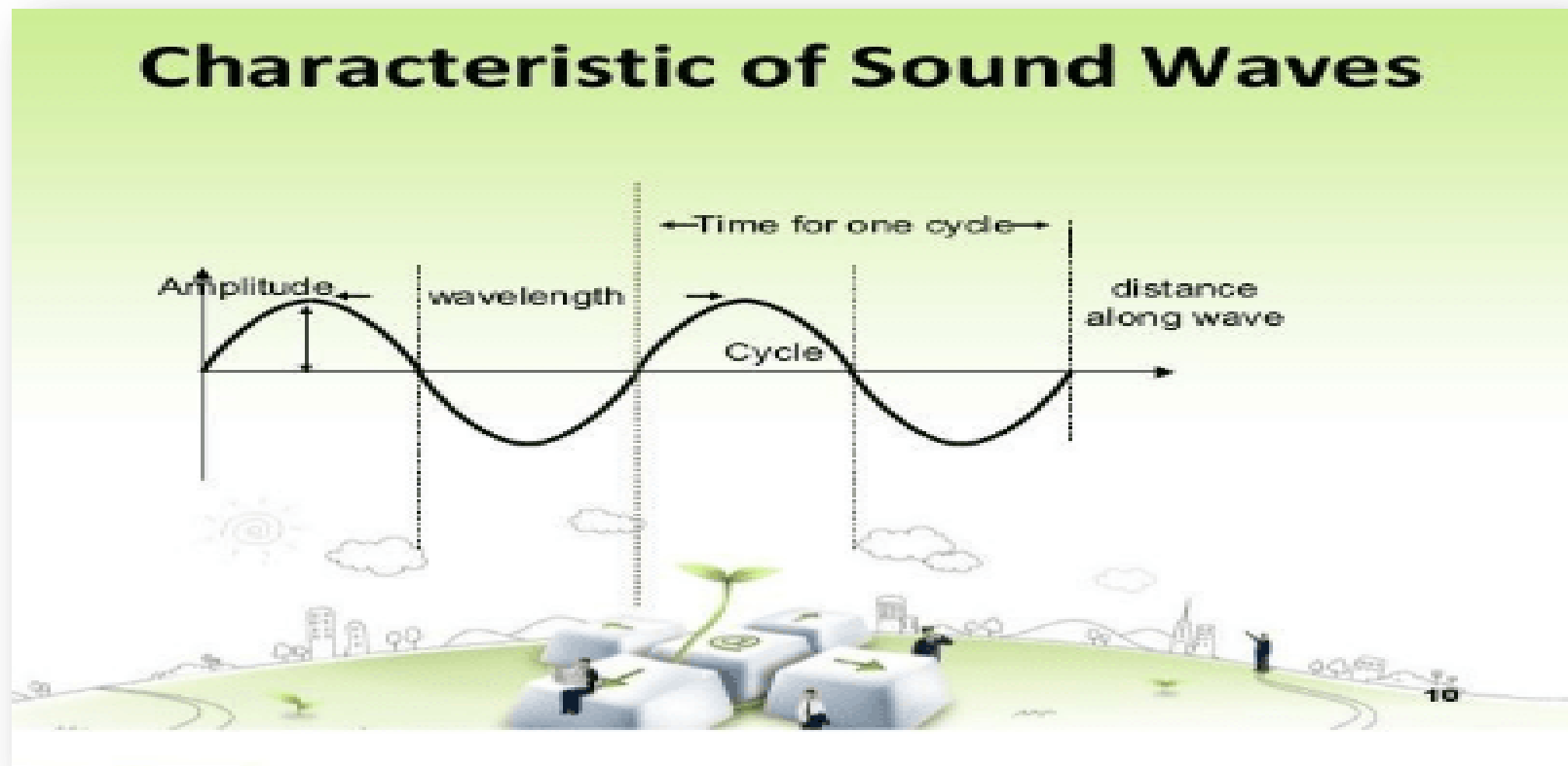
2. MEDIUM

- The matter or substance through which sound is transmitted is called a medium.
- A medium is necessary for the propagation of sound waves.
- The medium can be solid, liquid or gas.
- Sound cannot travel in vacuum.
- Wave that requires medium to propagate is called Mechanical wave.



3. WAVE

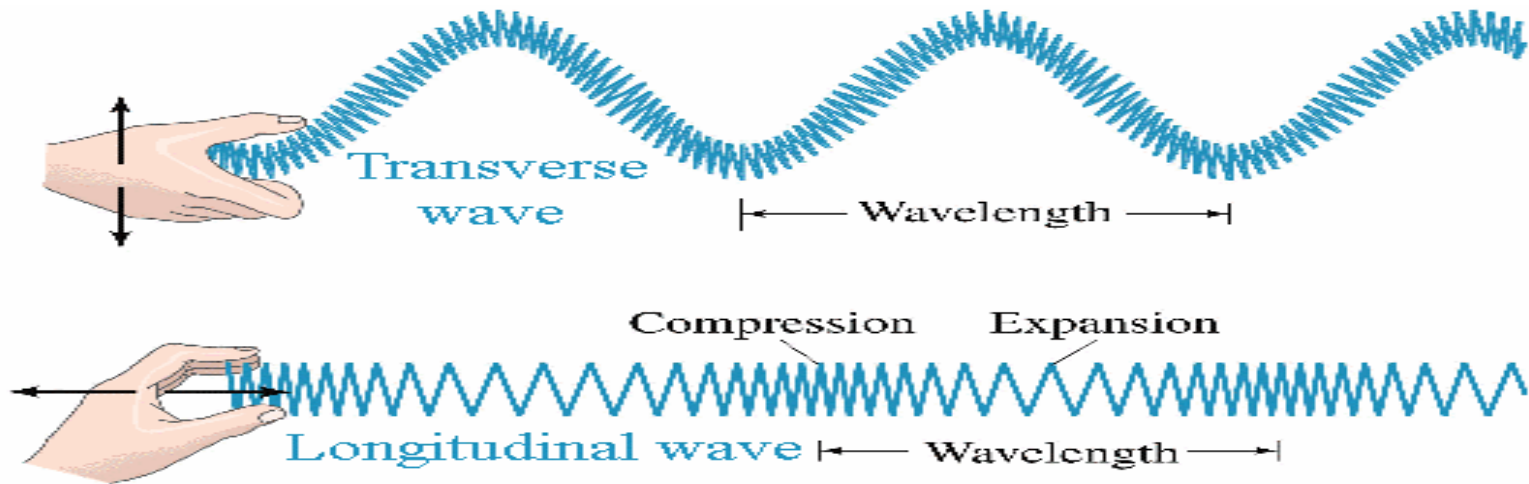
- Wave is a phenomenon or disturbance in which energy is transferred from one point to another without any direct contact between them. For example: Heat, light and sound is considered as a wave.



TYPES OF WAVES

Transverse waves:

- In this type of wave the particles of the medium vibrate in a direction perpendicular to the direction of propagation of the wave. For example: waves produced in a stretched string.



Longitudinal waves:

- These are the waves in which the particles of the medium vibrate along the direction of propagation of the wave. For example: sound wave.



COMPRESSIONS AND RAREFACTIONS:

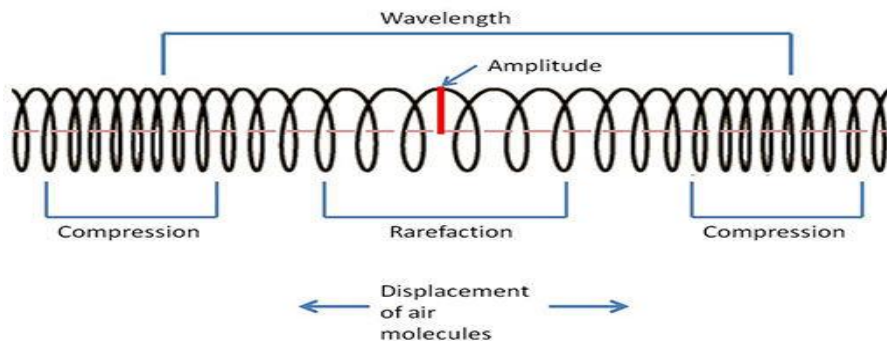
- Compression is the part of wave in which particles of the medium are closer to one another forming the region of high pressure and density.
- Compressions are represented by the upper portion of the curve called **crest**.
- Rarefaction is a part of the wave where particles spread out to form a region of low pressure and density.
- Rarefactions are represented by the lower portion of the curve called **trough**.

LONGITUDINAL WAVE

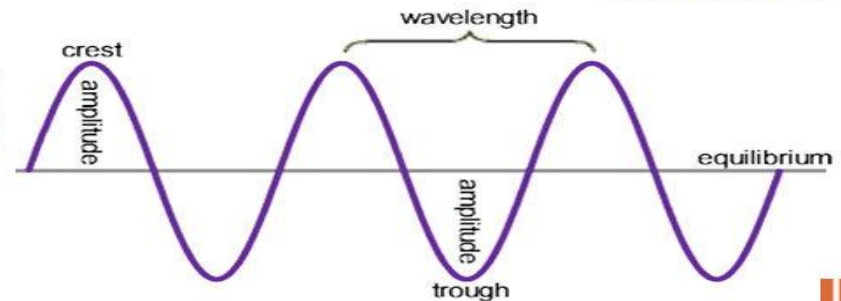
VS

TRANSVERSE WAVE

Longitudinal Wave



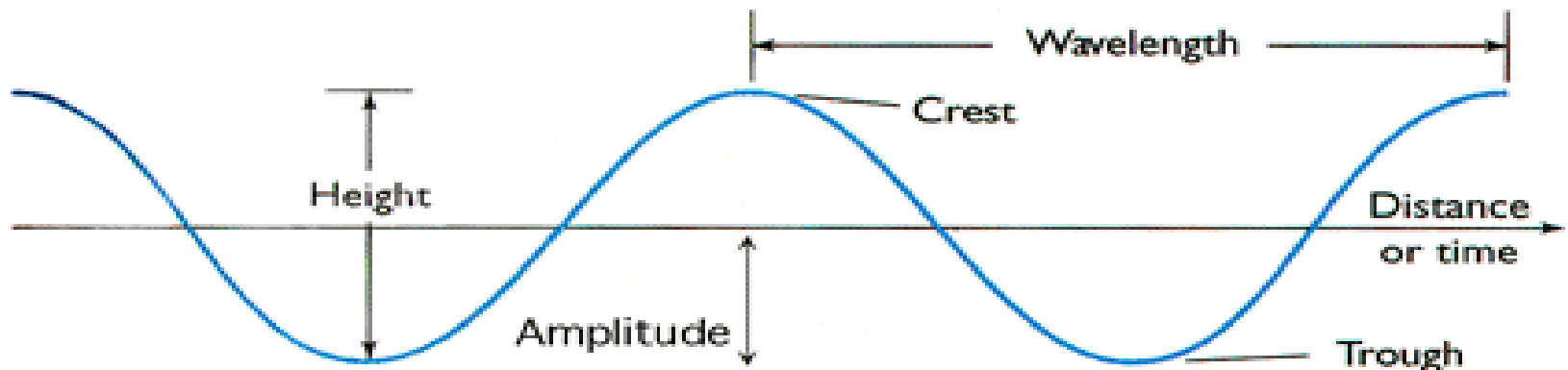
Transverse Wave



4. CHARACTERISTICS OF A SOUND WAVE

Sound waves have following characteristics:

- (1) Amplitude
- (2) wavelength
- (3) Frequency
- (4) Time period
- (5) Velocity



1. **Amplitude**

- The maximum displacement of each particle from its mean position is called amplitude.
- It is denoted by A.
- Its SI unit is metre (m).

2. **Wavelength**

- The distance between two nearest (adjacent) crests or troughs of a wave is called its wavelength.
- It is denoted by the Greek letter lamda (λ).
- Its SI unit is metre.

3. **Frequency**

- The number of vibrations per second is called frequency.
- The SI unit of frequency is hertz (Hz).
- The symbol of frequency is ν (nu).

4. **Time period**

- The time taken to complete one vibration is called time period.
- It is denoted by T.
- Its SI unit is second (s).
- The frequency of a wave is the reciprocal of the time period.
i.e., $\nu = 1/T$



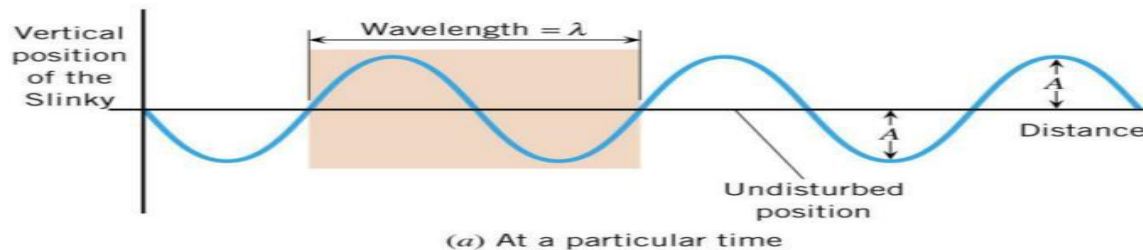
5. Velocity

- The distance travelled by a wave in one second is called velocity of the wave or speed of the wave.
- Its S.I. unit is metres per second (m/s).
- Velocity = Distance travelled/Time taken

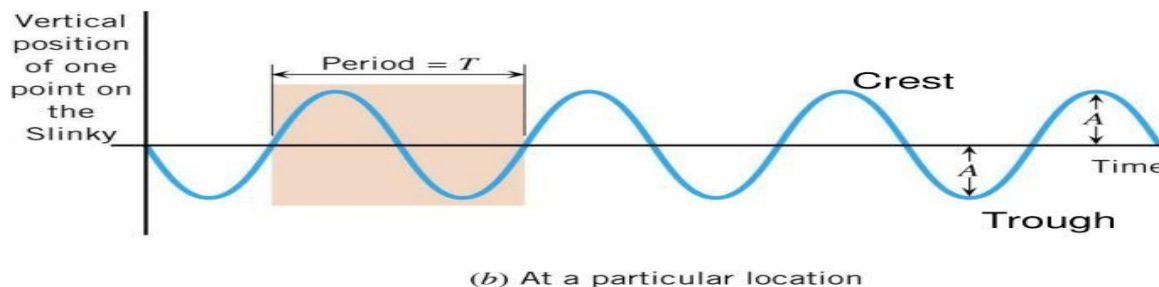
$\Rightarrow v = \lambda/T$, where λ = wavelength of the wave travelled in one time period T)

$\Rightarrow v = \lambda \nu$ (As $1/T = \nu$)

- Thus, Velocity = Wavelength $\times$ Frequency
- $v = \lambda \nu$ is called the wave equation.



Amplitude A is the maximum excursion of a particle of the medium from the particle's undisturbed position.



Wavelength λ is the horizontal length of one cycle of the wave.

1. Pitch And Loudness Of Sound

- **Pitch:** It represents shrillness or flatness of sound.
- It depends on the frequency of vibration. Higher the frequency of sound wave, the higher will be the pitch of sound and vice-versa.
- **Loudness:** It is a measure of the sound energy reaching the ear per second.
- It depends on the amplitude of the sound wave.
- It is measured in decibel 'dB'.

2. Music And Noise

- **Music:** It is the sound that is pleasant to hear. For example: Sound coming out of musical instruments)
- **Noise:** It is the sound that is unpleasant to hear. For example: Sound produced by vehicles.

3. Tone and Note

- **Tone:** A pure sound of single frequency is called tone.
- **Note:** An impure sound produced by mixture of many frequencies is called a note. For example: A musical note has tones of various frequencies.



5. AUDIBLE FREQUENCY

- Audible Frequency
- The audible range of human ear is 20 Hz and 20,000HZ, i.e., the human ears can hear only those waves whose frequency lies between 20 Hz and 20,000HZ.

Animal	Hearing range in Hertz
Humans	20 – 20,000
Bats	2000 – 110,000
Elephant	16 – 12,000
Fur Seal	800 – 50,000
Beluga Whale	1000 – 123,000
Sea Lion	450 – 50,000
Harp Seal	950 – 65,000
Harbor Porpoise	550 – 105,000
Killer Whale	800 – 13,500
Bottlenose Dolphin	90 – 105,000
Porpoise	75 – 150,000
Dog	67 – 45,000
Cat	45 – 64,000
Rat	200 – 76,000
Opossum	500 – 64,000
Chicken	125 – 2,000
Parakeet	200 – 8,500
Horse	55 – 33,500

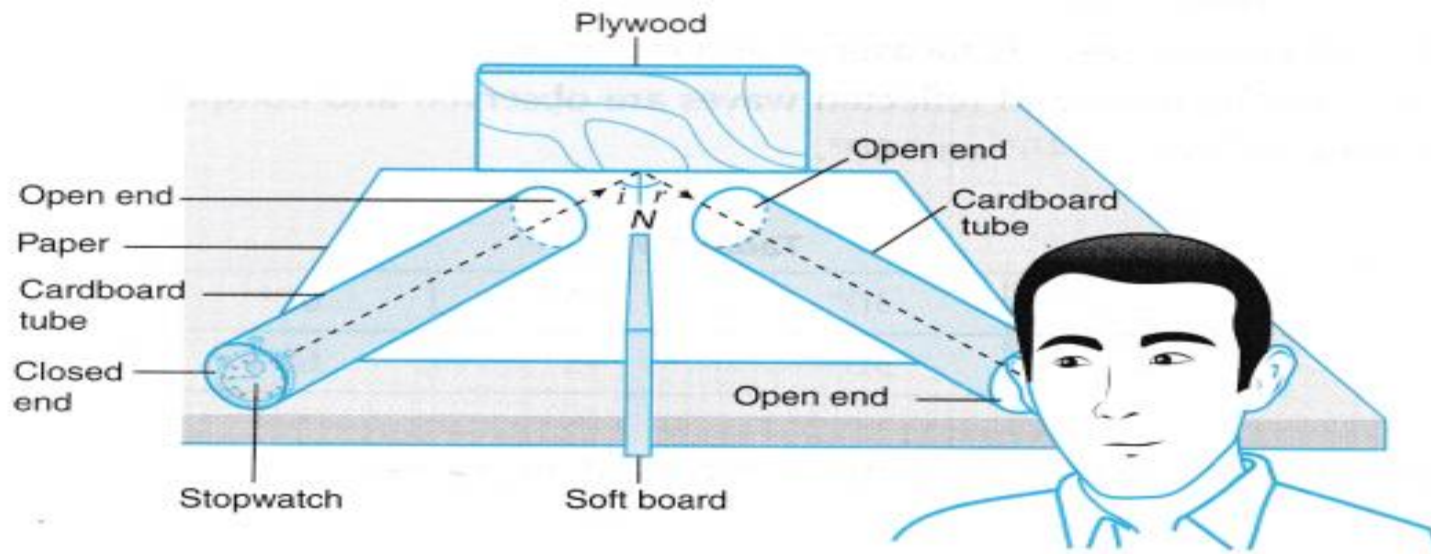
6. REFLECTION OF SOUND AND ITS LAWS

○ Reflection of sound

- When sound waves strike a surface, they return back into the same medium. This phenomenon is called reflection.

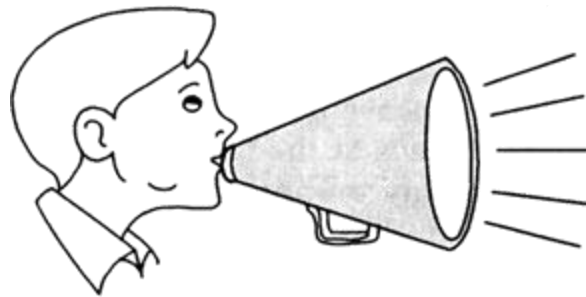
○ Laws of reflection

- There are two basic laws of reflection of sound:
 - (i) Angle of incidence is equal the angle of reflection.
 - (ii) The incident wave, the reflected wave and the normal all lie in the same plane.

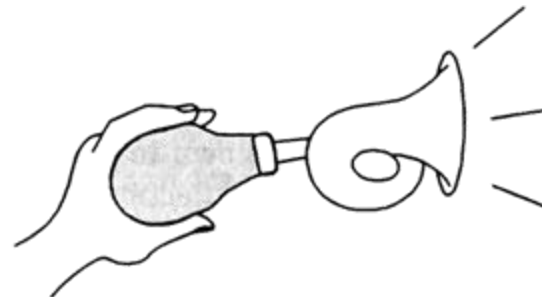


7. APPLICATIONS OF REFLECTION OF SOUND

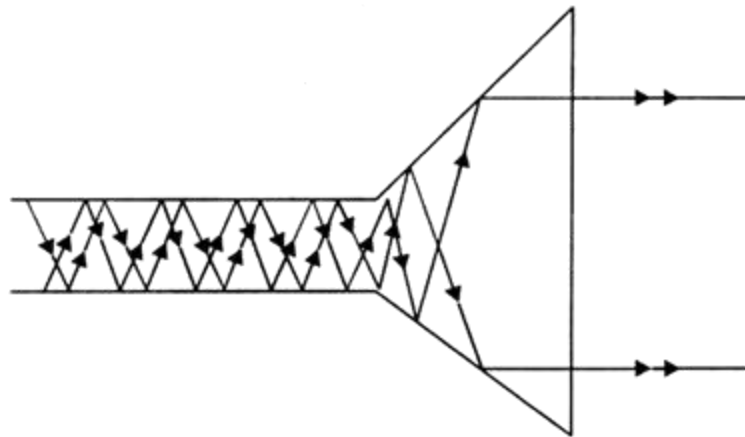
- Many instruments work on the basis of multiple reflections of sound:
- Megaphone, loudspeakers, bulb horns, musical instruments like trumpets, shehnais etc. are designed to send sound by multiple reflections in a particular direction due to which the amplitude of sound waves adds up to increase loudness of sound.



Megaphone

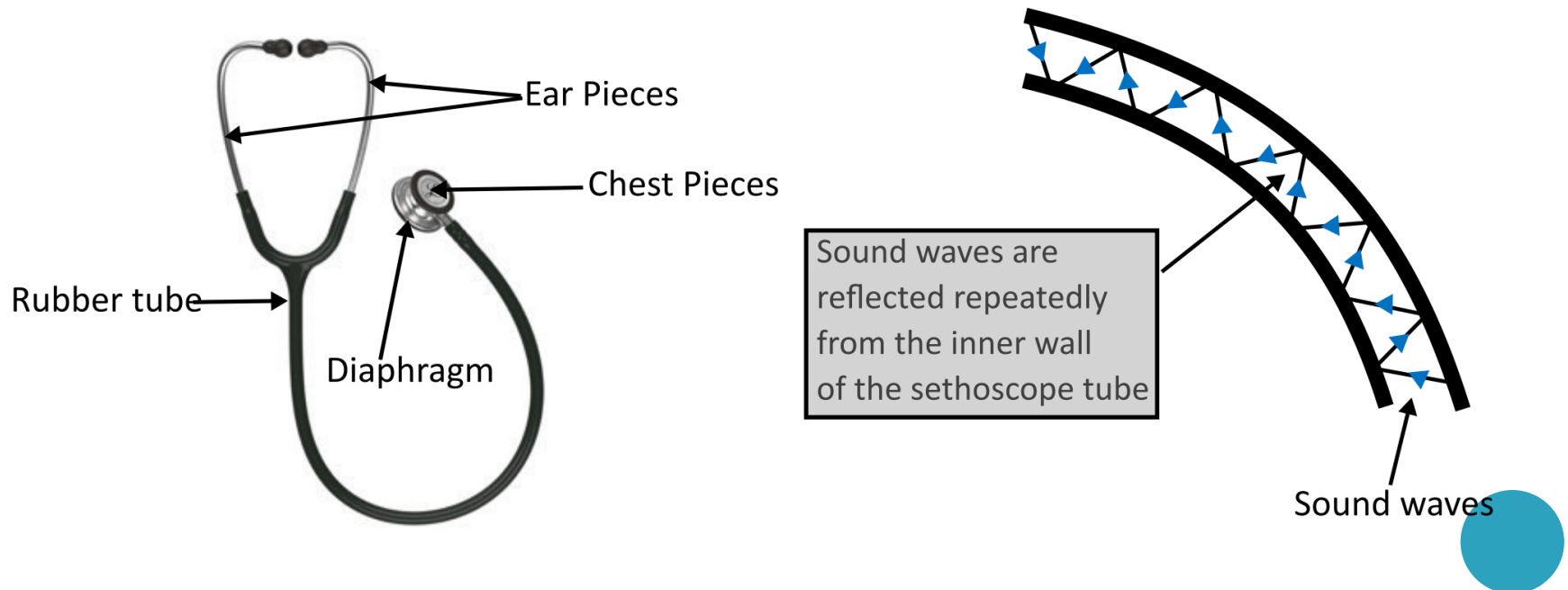


Horn



- Stethoscope which is used by doctors to listen to the sounds from the human body, also works on principle of multiple reflections of sound. Here, sound of heartbeat reaches the doctor's ears by multiple reflections.

Reflection of sound waves in Stethoscope





THANK YOU

BY: NITIKA MEHTA
PARAGON SENIOR SEC SCHOOL
MOHALI