HI

Chapter 6 Sound

Chapter Objectives

In this chapter, you will learn about:

- Sound and its different sources
- Sound as longitudinal wave
- Amplitude and frequency of sound
- Sound requires a medium to travel
- Reflection and absorption of sound
- Relative speed of sound in different media

Amaira is listening to songs on her music system. With the beats of song, she notices that the glass with water on the table is showing some vibrations. Why do you think this happens?

INTRODUCTION

Have you ever tried to understand how animals communicate? They communicate through sound.

Sound is the only way of communication among animals while it is the primary way of communication among humans.

In our everyday lives, we hear various sounds from both living and non-living things. Certain sounds, such as barking of a dog, speech in public places and beats of a drum, are easily heard and recognisable. However, certain sounds like whispering, fluttering leaves and low-volume music require a peaceful environment to recognise.

Fig. 6.1 Vibrating membrane of the drum transferring sound waves to the surroundings

HOW SOUND IS PRODUCED

Sound is produced by vibrating objects. For example, if you place your fingers gently on your throat while talking, you will be able to feel vibration. Thus, *sound is defined as a form of energy that is carried by waves produced by vibrating objects.*

When we throw a pebble in the water, it creates ripples in the water called water waves. Likewise, when a sound is produced, vibrations are created which enable us to hear sound. These vibrations are called **sound waves.** These vibrations then travel through a medium (air, water or solid) as sound waves. In this way, sound waves travel from one

Teaching Tip: Make students strike a frying pan using a spoon and keep one hand on the frying pan. Ask them what they observe. Let them come to the conclusion that the pan is vibrating back and forth.

source to another in all directions. When these sound waves reach our ears, they make our ear drums vibrate. The inner ear converts these vibrations into electric impulses. These are then carried by nerves to the brain, which identifies the sound. It is the brain which hears the sound while ears are the aids which help in hearing. Thus, we can say that sound always travels through a medium, such as gases, liquids and solids.

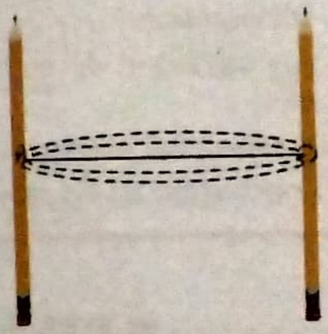
ACTION TIME 1

Aim: To show that sound is produced by the vibrating body.

Materials required: a thin metal wire and two long pencils

Procedure:

- Tie two ends of the metal wire to two pencils.
- Make sure that the knots are tight.
- Ask one of your friends to stretch the wire tight with the help of pencils.
- Pull the wire at the centre.
- What do you observe?



Observation: When the tightly stretched wire is plucked at the centre, it starts to vibrate. This vibrating wire produces sound. When the vibrations stop, no sound is produced.

Conclusion: Sound is produced by a vibrating body.

SOURCES OF SOUND

Sound waves are produced by various sound sources. Some sources of sound are tuning fork, musical instruments and humans. Let us study them in detail.

Tuning Fork

Tuning fork is a U-shaped instrument consisting of two arms called prongs and a stem, as shown in the Fig. 6.2.

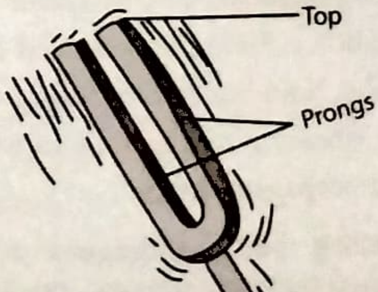


Fig. 6.2 Parts of a tuning fork

The prongs, on hitting with a rubber pad, vibrate and thus produce a sound. In all laboratory experiments, to study about sound and vibrations, a tuning fork of required frequency can be used.

INFO HUB

Tuning forks are used to tune certain musical instruments. It is also used by medical practitioners to assess a patient's hearing ability.

Let us perform an activity to check if the sound produced by a tuning fork is due to the vibration of the prongs.

Musical Instruments

Depending on the medium of vibration, musical instruments are mainly grouped into stringed instruments, percussion instruments and wind instruments.

Teaching Tip: Place a metal ruler on a tabletop with major part of it extending off table. Place one hand on the table to hold the ruler and vibrate the free end. Show to the students that vibrating part of the ruler is producing sound. | **Instrument:** An object that is played to produce musical sound

ACTION TIME 2

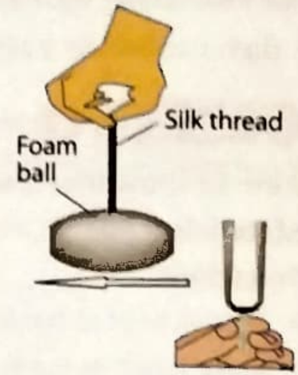
Aim: To check if the sound produced by a tuning fork is due to the vibration of prongs.

Materials required: tuning fork, rubber pad, small light foam ball and 15 cm silk thread

Procedure:

- Suspend the small foam ball by a silk thread.
- Hit one of the prongs of the tuning fork over the rubber pad.
- Carefully placing this vibrating prong close to your ear, you will be able to hear a sharp sound.
- Now, touch one of the prongs of the tuning fork to the foam ball.

What do you observe?



Observation:

A sharp sound will be heard when the tuning fork is placed close to the ears.

The foam ball will fly outwards as the vibrating prong touches it. This shows that the prongs are vibrating.

Conclusion: Sound produced in the tuning fork is due to the vibration of the prongs.

INFO HUB

Harp is one of the oldest instruments in the world. It dates back to 3000 BCE and was first depicted on the sites of ancient Egyptian tombs and Mesopotamian culture. Harp is Ireland's national symbol (emblem) making Ireland the only country to have a musical instrument as its national symbol.

SOUND AS LONGITUDINAL WAVES

When we speak, sound waves are generated. These are longitudinal, that is, the particles of the medium (air, water or solid) vibrate in a direction parallel to the direction in which sound waves travel.

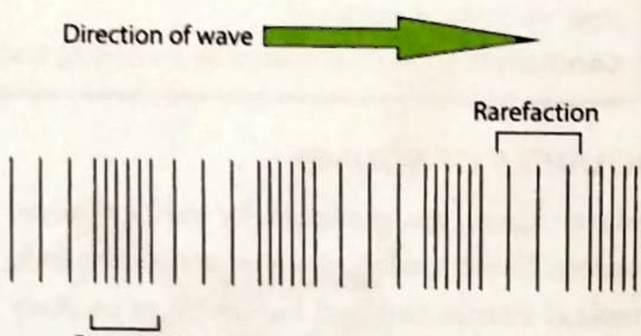


Fig. 6.3 Sound waves in air

Propagation of Sound

Sound cannot travel in vacuum, and needs a medium to propagate, i.e., to travel from one place to another. Sound waves need a medium such as, solid, liquid or gas to propagate. Let us consider a vibrating tuning fork to understand how sound propagates in air.

Any vibrating body undergoes to-and-fro motion about its mean position. For example, when a tuning fork vibrates, its prongs move inwards and outwards about their mean

Propagate: Transmit or be transmitted through a medium positions. When the prongs move outwards, molecules surrounding it move outwards, causing an increase in the pressure. This pushes the molecules to come close to each other. This region of high pressure is called **compression**. When the vibrating prongs move inwards, molecules surrounding it move inwards, causing a decrease in the pressure. This pulls the molecules apart. This region of low pressure is called **rarefaction**. *As the prongs keep vibrating, sound travels as alternative compressions and rarefactions and finally reaches our ears.*

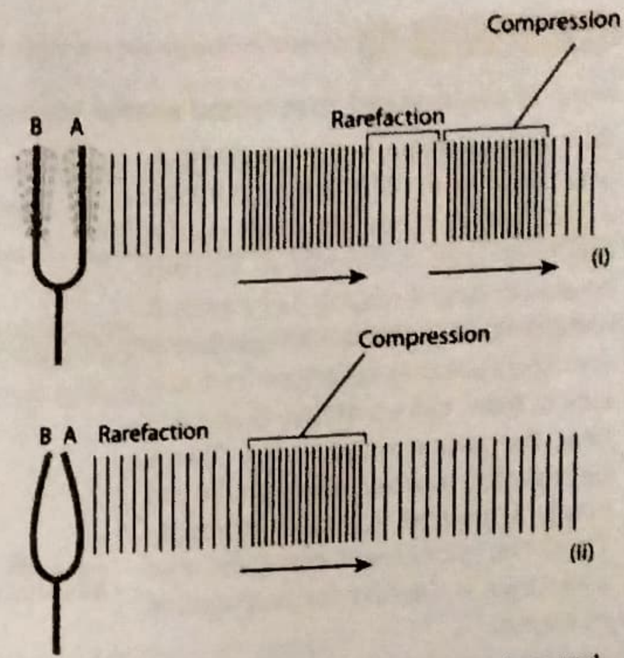


Fig. 6.4 Vibrating tuning fork causes compressions and rarefactions

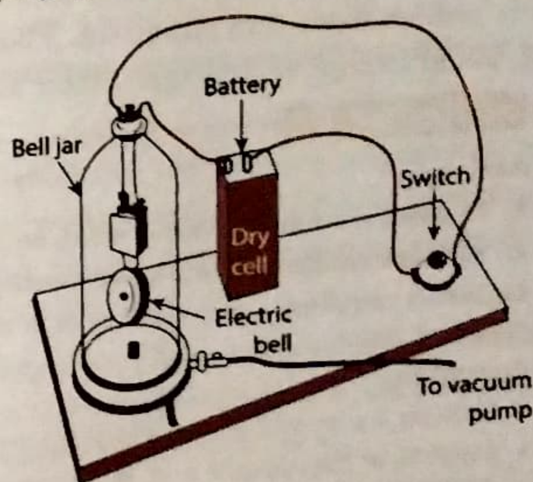
ACTION TIME 3

Aim: To demonstrate that sound needs a medium to propagate.

Materials required: a bell jar, an electric bell, rubber cork, vacuum pump, connecting wires, an electric switch and battery.

Procedure:

- Place the electric bell in the bell jar as shown in the figure. Close the lid properly using a rubber cork.
- Complete the circuit using a battery and a switch as shown in the figure.
- Switch 'ON' the circuit and record your observation.
- Now, gradually take out the air from the jar using the vacuum pump connected to the jar.
- Observe the volume of sound each time as you pull out the air from the jar.
- Repeat the steps until you pull out most of the air from the jar.



Bell jar experiment

Conclusion:

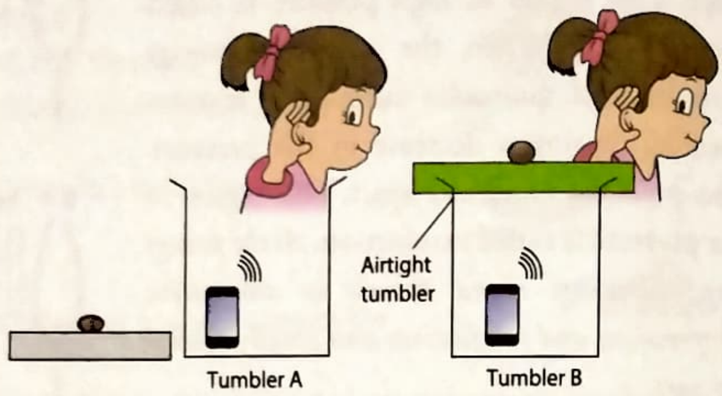
In this experiment, you will hear a sound before pulling out the air. As you remove the air from the jar, the volume of sound decreases. At a point when there is no air inside, no sound will be heard. Therefore, **we can conclude that sound requires material medium for propagation**.

Vacuum: A space entirely devoid of matter

ACTION TIME 4

Aim: To understand that sound always travels through a medium.

Take two tumblers and name them A and B. Keep a cellphone in tumbler A and keep it open. Now, call up the cellphone kept in tumbler A. You will be able to hear it ringing. Let mobile A remain inside it. Now, take tumbler B and keep another cellphone in it and lock it. Now, call up mobile B. Did you hear the phone ringing? No. This is because the tumbler is airtight. Sound needs a medium to travel through. Thus, this experiment concludes that a medium is needed for propagation of sound.



Propagation of Sound in Solid, Liquid and Gas

We know that sound is produced from vibrating objects. Such vibrating objects disturb the particles that they are in contact with and set them into vibrations. Thus, for the sound energy to propagate, there should be particles. Therefore, sound requires a medium to travel through.

The molecules in solids are closely packed than that of liquid and gas. The molecules of liquid are closer to each other than that in gas. Therefore, **particles in solids easily transfer sound energy than that in liquids and gases.**

ACTION TIME 5

Aim:

1. **To check if sound travels in solid, liquid and gas.**
2. **To check whether sound travels equally in different media.**

Materials required: a mini alarm clock, a zip-lock bag, small bucket of water

Procedure:

- Place an alarm clock at one end of the table
- Standing at the opposite end, listen to the sound produced by the clock as the second's hand moves.
- Now, hear the sound by placing your ear close to the table.
- Note down your observations
- Cover the alarm clock using a zip-lock bag.
- Place it in a bucket of water
- Place your ear closer to the surface of water and hear the sound.
- Were you able to hear the sound clearly in all the media?
- When was the sound feeble, loud and loudest?

Observing how sound travels in water.

Feeble: Weak and without energy

In this experiment, you will observe that the sound of the second's hand of the clock was heard in all the three media. Also, you will hear a louder sound through the table and a sound with moderate volume through water and a feeble sound through the air.

Hence, **we can conclude that sound propagates through solid, liquid and gas. Sound travels better and faster in solids than in liquids and gases.**

Quick Check 1

A. State whether the following sentences are True or False.

1. Sound is a form of energy. ....
2. Drum is not a source of sound waves. ....
3. Sound is produced by a stationary object. ....
4. Sound travels in a vacuum. ....
5. Sound is sensed when a vibrating particle from the sound-producing source reaches our ear drums. ....

B. Fill in the blanks.

1. Sound requires .... to propagate.
2. Generally, sound travels fastest in .... medium.
3. Sound propagates in a medium as series of .... and ....
4. Unlike ...., ... travels faster in solid.

TERMS RELATED TO A SOUND WAVE

The terms associated with a sound wave are ***amplitude***, ***frequency***, *time period* and ***wavelength***. Let us understand each in detail.

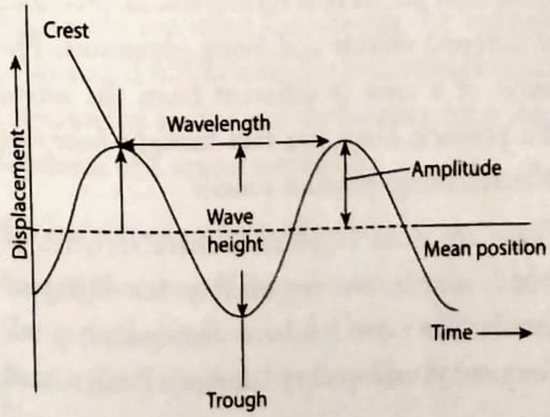


Fig. 6.5 Propagation of a sound wave

1. **Amplitude:** *The maximum displacement of a wave from its mean position is called amplitude.* The SI unit used to measure amplitude is metre (m).
2. **Frequency:** *The number of vibrations produced by a vibrating body in one second is called frequency.* It is denoted by the letter *f* or *n*.

   The SI unit used to measure frequency is Hertz (Hz). If any particle produces one vibration in one second, then its frequency is 1 Hz.
3. **Time period:** *Time taken by a particle to complete one vibration or oscillation is called the time period.* The SI unit used to measure time period of a wave is second (s).

If f is the frequency of vibrations and T is the time period, then f vibrations are produced in one second.

Therefore, time taken to complete one vibration is given by,

$$T = \frac{1}{f}$$

Hence, time period $(T) = \dfrac{1}{\text{frequency } (f)}$

4. **Wavelength:** *The distance between consecutive crests or troughs is called wavelength.* In sound waves, wavelength can be defined as the distance between consecutive compressions or rarefactions. The SI unit of wavelength is metre. It is denoted by the Greek letter 'λ'.

TYPES OF SOUND

In everyday life, we hear various sounds. Some sounds are pleasant and some are unpleasant. Depending upon its pleasant or unpleasant sensation to the ears, sound is categorised into musical and noisy.

For example, sound produced by most musical instruments and singers is pleasant to hear. These pleasant sounds are produced by regular vibrations.

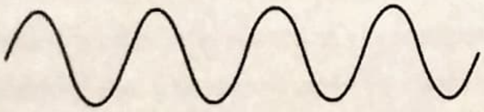


Fig. 6.6 Musical wave (regular vibrations)

On the other hand, sound produced by a vehicle and machines are unpleasant to hear. These unpleasant sounds are produced by irregular vibrations.

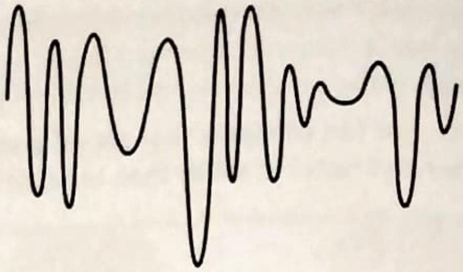


Fig. 6.7 Noise wave (irregular vibrations)

INFO HUB

A sound which has a pleasing sensation on the ears is called music.
A sound which does not have a pleasing sensation on the ears is called noise.

Table 6.1 Differences between music and noise

Music	Noise
1. Music is produced by regular vibrations in a medium.	1. Noise is produced by irregular vibrations in a medium.
2. Music is generally pleasing to listen to.	2. Noise is unpleasant to hear.
3. Amplitude and the frequency of a musical wave do not change.	3. Amplitude and the frequency of a noisy wave change.

CHARACTERISTICS OF SOUND WAVES

In our daily life, we hear various sounds produced by different objects and living organisms. The sound of a crow is different from the sound of a peacock. Have you ever thought how two different things produce sound?

There are three important characteristics of sound, which are responsible for different sounds. They are loudness (intensity), pitch (frequency) and quality (timbre). Each sound

Crest: Top of or highest part of something | **Trough:** A hollow between two crests of a wave that we hear is a unique combination of these characteristics.

Loudness

Loudness is the characteristic of a sound which distinguishes feeble sound from a loud sound of the same frequency. **Loudness of a sound relates to the amount of sound energy received by unit area per second.**

Loudness of sound depends on the following:

Amplitude of the sound

As the amplitude of sound wave increases, loudness increases. Amplitude of a wave is directly proportional to the amount of energy it carries. Therefore, greater the energy the sound wave carries, louder is the sound produced.

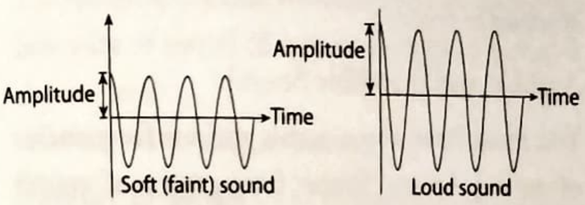


Fig. 6.8 Sound waves of same frequency but different amplitudes

Distance between the source of sound and the listener

If we move towards a loudspeaker, the loudness of the sound will increase. Hence, as **the distance between the source and the listener decreases, loudness of a sound increases.**

Area of the vibrating body

Larger the area of the vibrating body, louder the sound produced. A larger drum will produce more sound than a smaller drum.

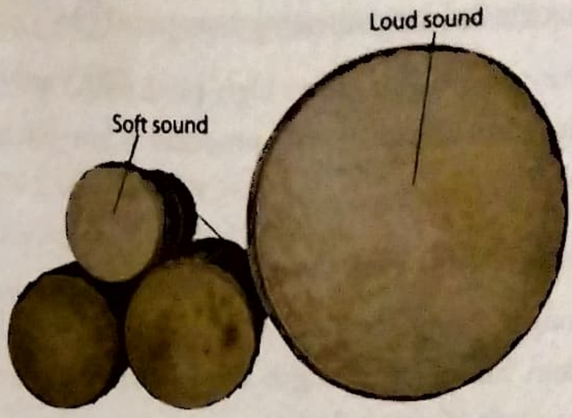


Fig. 6.9 Loudness of the sound depends on the area of a vibrating body

Pitch

Pitch is the characteristic of a sound wave which determines the sharpness or shrillness of a sound wave. It is the effect produced in the ear due to the sound of a particular frequency.

Pitch depends upon the frequency of a vibrating body. Higher the frequency of a vibrating body, larger is the pitch and lower the frequency, lesser is the pitch of the body.

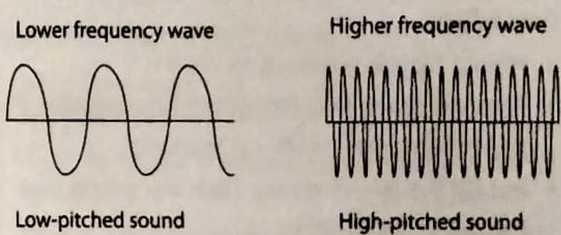


Fig. 6.10 Pitch depends upon frequency of a vibrating body

Pitch of a sound wave depends on the following:

Frequency of sound wave

Pitch of a sound increases with increase in frequency.

Length of vibrating air column

Pitch of a vibrating air column increases with the decrease in the length of the air column.

Thickness of the vibrating string

Thinner string produces high-pitch sound wave whereas a thicker string produces a low-pitch sound.

Length of the vibrating string

Longer the string, lower is the pitch of a sound wave. Shorter the length of the string, higher the pitch of a sound wave.

Most of the string and wind instruments work on the above-mentioned principle. Sound made by a bird has a higher pitch and is, therefore, shriller than a lion's roar.

Let us perform an activity to show that pitch of a sound increases with increase in the frequency.

ACTION TIME 6

Aim: To show that pitch of a sound increases with increase in the frequency.

Materials required: A paper card and a bicycle wheel.

Procedure:

- Hold a bicycle wheel at its centre.
- Ask one of your friends to hold the edge of a paper card against the cycle spokes.
- Rotate the wheel slowly. Hear the sound that the paper card makes.
- Now, increase the speed of the rotating wheel. Again, hear the sound that the paper card makes.

What do you hear?

You will find that when the wheel moves slowly, a low-pitch sound will be heard. When the wheel moves faster, a high-pitch sound will be heard.

Conclusion: When the speed of rotation of the cycle wheel increases, number of times that the spoke hits the card increases (frequency). So, when a higher-pitch sound is produced, the sound becomes shriller.

Quality (Timbre)

If you pluck strings of the same length of two different musical instruments with equal force, you will notice that the notes produced by them are different.

The property which distinguishes between two sounds of two different musical instruments, having the same pitch and loudness, is called quality of sound or timbre.

Audible and Inaudible Sounds

You must have come across various frequencies of sound waves. Some frequencies of sound waves are within audible ranges and others are not. Human beings can hear sounds of frequencies between 20 Hz and 20,000 Hz. Vibrations below 20 Hz and above 20,000 Hz are not audible to humans. Vibrations below 20 Hz are called **infrasonic sounds**, vibrations between the frequency range of 20 Hz to 20,000 Hz are called **sonic sounds** and vibrations above 20,000 Hz are called **ultrasonic sounds**.

INFO HUB

Whales, such as blue, fin and humpback, possess special hearing abilities. It is found that these animals are best adapted to hear low frequencies.

Quick Check 2

A. State whether the following sentences are True or False.

1. Unit of frequency is metre. ....
2. Time taken by a particle to complete one vibration is called the time period. ....
3. The maximum displacement of a wave from its mean position is called wavelength. ....
4. The distance between consecutive crests or troughs is called amplitude. ....
5. Amplitude and the frequency of the musical wave do not change. ....

B. Fill in the blanks.

1. As distance between the source and the listener increases, loudness of a sound ....
2. .... is the effect produced in the ear due to the sound of a particular frequency.
3. Characteristics of sound waves are ...., ... and ....
4. The property due to which notes of two different musical instruments having the same pitch and loudness can be distinguished is called .... of sound.
5. .... string produces high-pitch sound wave, whereas longer string produces low-pitch sound.

Unit of Sound

The loudness of sound is measured in decibels (dB). Intensity of sound of various sources of sound is shown here.

Table 6.2 Intensity of sound sources

Source of sound	Sound intensity (dB)	Intensity ($W\ m^{-2}$)
Threshold of pain	120	1
Busy traffic	70	10^{-5}
Conversation	65	3.2×10^{-6}
Stationary car	50	10^{-7}
Whisper	20	10^{-10}
Rustle of leaves	10	10^{-11}
Threshold of hearing	0	10^{-12}

REFLECTION AND ABSORPTION OF SOUND

Like light, sound also gets reflected whenever it comes across an obstacle like a wall or a mountain. Substances having smooth and hard surfaces are considered good reflectors of sound. For example, metals, walls, etc. Bad reflectors of sound are soft and fluffy. For example, clothes, wall papers, curtains, etc. They absorb sound. **Sound also obeys the laws of reflection.**

Let us perform an activity to check if sound obeys the laws of reflection.

ACTION TIME 7

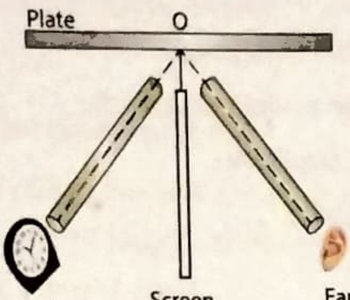
Aim: To check if sound follows the laws of reflection.

Materials required: two hollow cylindrical tubes, thick metal plate, cardboard screen and a stopwatch

Procedure:

- Fix the thick metal sheet on the table. Mark the centre of the sheet as 'O', as shown in the figure.
- Place the cardboard screen perpendicular to the metal sheet and in line with the metal plate, as in the figure.
- Take two hollow cylindrical tubes and arrange them on the table in such a way that one end of both the tubes is directed towards 'O'.
- Keep a clock near the open end of one of the cardboards.

- Adjust the other pipe till the sound of the clock is heard.



- Trace the location of the metal plate and two cardboards.
- Measure the angle of incidence and angle of reflection using a protractor.
- Repeat the activity by keeping the clock and the cardboard at different angles.

Explain what you infer from your observations.

Conclusion: Sound also obeys laws of reflection.

Echoes

Some of us might have enjoyed making sounds in an empty room. When you make a sound in an empty room, the sound bounces off the walls of the room. Hence, we hear our own voice repeatedly. This is called an **echo**. Hence, *an echo is the reflection of sound that reaches a listener with a delay, after the direct sound is heard.*

Our brain retains the effect of any sound for 0.1 second. This time is called **time period of persistence**. Therefore, **we cannot distinguish two different sounds, if those sounds have reached our brain within 0.1 second**.

Hence, the echo of a sound will be heard distinctly only when it reaches our ears after 0.1 second, after the original sound dies out.

The speed of sound in air is about 332 m s^{-1}. The distance travelled by sound in 0.1 second = 332 × 0.1 = 33.2 m. This is twice the minimum distance between a source of sound and the reflecting surface.

Hence, the distance between the source and the reflecting surface = 33.2/2 = 16.6 m.

Therefore, **we can hear an echo only when the reflecting surface is beyond** 16.6 m **from the source**.

INFO HUB

In valleys, where mountains are all around, a sound may get reflected many times to form multiple echoes.

SONAR

SONAR is an acronym of Sound Navigation and Ranging. This instrument works on the principle of reflection of sound. It is fixed in navigating ships and is used to locate the objects that are under the ocean.

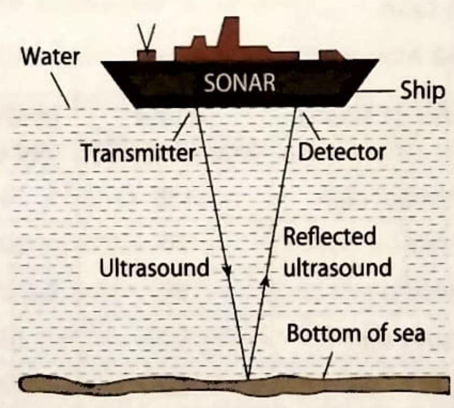


Fig. 6.11 SONAR in ships

SONAR fitted in a ship sends sound waves of high frequency, called ultrasonic sound waves, towards the bottom of the sea. The sound is received back after it is reflected from objects at the bottom of the sea. The time interval for sound waves to travel from the source to the receiver after reflection is recorded.

Teacher's Tip: Get the students to touch their throats while they speak. Ask them, whether they feel the vibration while speaking. Elaborate. | **Navigate:** Plan and direct the route or course of a ship

Knowing the speed of sound in water (1,500 m s^{-1}) and having the time taken by the reflected sound to reach the sonar, depth of a sea or location of objects can be calculated.

The distance travelled by the sound wave is twice the distance of the object from the surface of the ocean. If d is the distance of the object, then

$$2d = v \times t$$

NUMERICAL

SONAR transmits ultrasonic sound waves towards the bottom of the sea. The time interval recorded to receive the reflected sound is 1.8 s. If the speed of ultrasonic sound in water is 1,500 m s^{-1}, find the depth of a sea.

Solution:

Time taken to reach the sonar after reflection = 1.8 s

Speed of sound in water = 1,500 m s^{-1}.

Distance travelled by the sound = speed of sound × time taken = 1,500 × 1.8

= 2,700 m

$\therefore$ Depth of the sea $= \frac{2,700}{2} = 1,350$ m.

Relative speed of sound in different media

Sound energy travels at different rates in different media. The speed of sound increases as the density of the medium increases. Remember that the density of solid is more than the density of liquid, and density of liquid is more than the density of gases. Therefore, sound travels fastest in solid, slower in liquid, and slowest in gas.

In addition, it is worthy to know that:

- In liquids, speed of sound depends on the pressure and density of the liquid.
- In gases, speed of sound depends on temperature and humidity.

If v_{solid} is the speed of sound in solid, v_{liquid} is the speed of sound in liquid and v_{air} is the speed of sound in air, then you can easily remember that:

$$v_{solid} > v_{liquid} > v_{air}$$

INFO HUB

Speed of sound in air is approximately 332 m s^{-1}, in water about 1,500 m s^{-1} and in iron or steel (solids) it is about 5,100 m s^{-1}.

To Find the Speed of Sound in Air

We can calculate the speed of sound using the formula:

$$\text{Speed of sound} = \frac{\text{Distance travelled by the sound}}{\text{Time interval}}$$

Table 6.3 Speed of sound in different materials

Material	Speed of sound
Rubber	60 m s^{-1}
Air at 40 °C	355 m s^{-1}
Air at 20 °C	343 m s^{-1}
Lead	1,210 m s^{-1}
Gold	3,240 m s^{-1}
Glass	4,540 m s^{-1}
Copper	4,600 m s^{-1}
Aluminium	6,320 m s^{-1}

INFO HUB

Thunderstorms are heard after the flash of lightning!
Do you know why?
Light travels faster in air than sound. The speed of light is 3×10^8 m s^{-1} and that of sound in air is 332 m s^{-1}. Thus, lightning will be seen as soon as it occurs. However, the sound takes more time to reach Earth.

Quick Check 3

Fill in the blanks.

1. The pitch of a sound of any stringed instrument can be altered by changing the .... of the string.
2. In .... instruments, air column vibrates to produce music.
3. Sound of frequencies below .... Hz and above .... Hz is not audible to humans.
4. For a distinct echo to occur, the distance between the source and the reflecting surface should be above .... m.
5. The acronym for sound navigation and ranging is ....

KEY TERMS

Compression: The region in a sound wave, where molecules come closer to each other due to pressure

Rarefaction: The region in a sound wave, where molecules move away from each other due to low pressure

Loudness: The characteristic of a sound wave which distinguishes feeble sound from a loud sound

Pitch: The characteristic of a sound wave which determines the sharpness or shrillness of sound

Timbre: The property which distinguishes between two sounds of different musical instruments

Time period: Time taken for one complete vibration by the particle

Echo: A phenomenon in which sound waves come back to the source after reflection

QUICK NOTES

- Sound is a form of energy produced by all vibrating bodies.
- Amplitude, frequency, wavelength and time period are the important terms used to define a sound wave.
- Sounds which are pleasant to the ear are called music while sounds which are unpleasant to the ear are called noise.
- The unique combination of three characteristics, namely, loudness, pitch and quality (timbre), helps us to differentiate between sounds.
- Tuning fork, musical instruments and humans are some of the sources of sound.
- An important part of the throat, called the voice box (larynx), is responsible for sound production.
- A repetition of sound produced by the reflection of sound waves from a reflecting surface is called an echo.
- SONAR is an acronym of 'sound navigation and ranging' and is used to find the depth of a sea.

RUN-THROUGH

I. Very Short Answer Questions.

A. Tick (✓) the correct option.

1. Pressure of molecules in the region of compression is:
   a. high ☑ b. low ☐ c. medium ☐ d. nil ☐
2. Speed of sound in liquids is .... the speed of solids.
   a. greater than ☐ b. lesser than ☑
   c. same as ☐ d. none of these ☐
3. The human ear can hear sound waves having frequency between:
   a. 20 and 20,000 Hz ☑ b. 20,000 and 2,000,000 Hz ☐
   c. 20 and 2,000 Hz ☐ d. 200 and 2,000,000 Hz ☐
4. Amplitude is:
   a. the maximum displacement of a wave from its mean position. ☑
   b. number of vibrations in one second. ☐
   c. one complete to-and-fro motion of a vibrating body. ☐
   d. distance between successive crests or troughs. ☐
5. Sound cannot travel through:
   a. solid ☐ b. liquid ☐
   c. gas ☐ d. vacuum ☑
6. Tuning fork is an instrument used by:
   a. postman ☐ b. doctors ☑
   c. musicians ☐ d. both (b) and (c) ☐

B. Fill in the blanks.

loudness, good, bad, infrasonic, 332 ms^{-1}, solids, liquids, above, below

1. Sound travels faster in ...Solids... than in ...liquids... .
2. The speed of sound in the air is ...332 m/s...
3. The characteristic of sound which distinguishes soft sounds from loud sounds is called ...loudness... .
4. The frequency of ultrasonic sound is ...above... 20,000 Hz.
5. Metals with shiny surfaces are ...good... reflectors of sound.
6. Vibrations below 20 Hz are called ...infrasonic... sounds.

C. State whether the following statements are True or False.

1. A sound wave has alternate crests and troughs. true
2. Musical notes are made by irregular vibrations. false
3. Normal hearing range of human beings is between 180 and 200 dB.
4. The SI unit to measure frequency is metre. false
5. Pitch of a sound depends on frequency. true
6. SONAR is used to measure the depth of the sea. true

D. Match the following:

Column A
1. Amplitude
2. Pitch
3. SONAR
4. Tuning fork
5. Ultrasonic sounds

Column B
a. Vibrations above 20,000 Hz
b. Maximum displacement of wave from mean position
c. Depends on frequency of sound
d. Sea depth
e. Source of vibration in a laboratory

II. Short Answer Questions.

1. A large drum produces louder sound than a smaller drum. Why?
2. Echo will be heard only in large buildings and not in smaller houses. Justify.
3. How does a reed instrument produce sound?
4. SONAR works on the principle of reflection of sound. Explain.
5. Explain how loudness and amplitude are related.
6. Why do we see lightning before hearing the thunder?

III. Long Answer Questions.

1. Describe an experiment to prove that sound cannot travel in vacuum.
2. What is a tuning fork? Explain it in detail.
3. Name different types of musical instruments. Explain them in detail.
4. Explain how humans produce sound.
5. What are the factors on which loudness of a sound depends?

IV. Challenge

1. Can astronauts communicate verbally in space? Explain why.
2. Devise methods to build different musical instruments using easy-to-find materials.
3. The speed of sound is dependent on the type of medium and the temperature of the medium. How?
4. What happens to the speed of sound when the temperature of the medium increases?
5. How are time period and frequency of sound related to each other?
6. The distance between the consecutive compression and rarefaction is 1 mm when sound travels through a medium. What is the wavelength of the wave?
7. A sound wave makes an angle of 25° with the surface on which it strikes. What is the angle between the incident and reflected waves?

V. Enrichment

A. Apply: Work in groups. Each group should prepare a musical sound using the objects in the classroom.

B. Project: Designing a soundproof box.

Take a shoe box or any other cardboard box. Place a foam or an egg carton inside of the box such that it is covered completely. Now, cover the box. Your soundproof box is ready

Subject Connect

- Using the Internet find out if sound recording rooms are soundproof.
- Why have we used a foam or an egg carton in the above activity?

Life Connect

C. Echolocation in Bats

Bat trying to locate and catch prey using echolocation

Bats are nocturnal mammals, that is, they are active at night. Earlier it was thought that bats are blind, but in fact they can see almost as well as humans. However, at night, their ears are more important than their eyes. During night they find their way and prey, using sounds. Bats use a special sonar system called 'echolocation,' meaning they find things using echoes.

As bats fly they make shouting sounds. The echoes they get back from their shouts give them information about anything that is ahead of them, including the size and shape of the prey (an insect) and which way it is going. The sounds produced by bats are too high for most humans to hear (although sometimes children are able to hear them). We can hear the sounds bats make using a special instrument called a 'bat detector'.