

Chapter  
**11**

# Investigating Sound

Dolphins and whales use sounds to send messages to each other underwater. They also listen sounds to help them find their way.

## Student Learning Outcomes

After completing this chapter, you will be able to:

- Describe sound as a form of energy.
- Compare the speed of sound in solids, liquids and gaseous mediums.
- Identify a variety of materials through which sound can travel.
- Explain that how does a human ear receive sound waves.

We are surrounded by sound. There is a great variety of sounds. Sound is all around us like air. Have you not listened these sounds?

- | the call of your sweet mother to awake you
- | the sound of water running in the sink
- | the chirping of birds outside the window
- | the voices of hawkers in the street
- | the ringing of the school bell

Fig.11.1: The bird is chirping.



Some sounds are **loud** and some are **soft**. Some sounds are **pleasant** to hear, but loud noise is an **unpleasant** sound. Which sound do you like, singing of a bird in a tree or noise of running traffic on the road?

### How does sound produce?

Sound is produced when matter moves back and forth very quickly. A back and forth movement is called a **vibration**. Sound is produced only when something vibrates.

Sounds are produced in solids, liquids and gases.

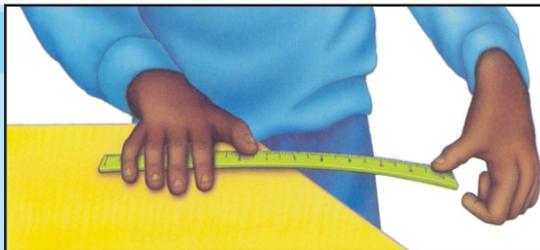
If we touch our throat while we are talking, we can feel the vibrations in our voice box. Strike a spoon on the side of the cup and see the vibrations. Mosquitoes produce buzzing sound due to the vibration of their wings. When someone speaks, vibrations are produced in the air and we hear the sound.



Fig.11.2: The boy is playing a flute.

A flute (bansuri) produces sound due to the vibrations of air particles.

Hold one end of your wooden ruler firmly on the edge of a table. Now press the free end of the ruler and release. You will hear the sound when the ruler vibrates.



### Do you know?

Loons are very interesting birds by their voice. When they produce sound, it hears as they are laughing.



## Sound as a Form of Energy

We know that energy can do work and work is done when something is moved. We have also learnt that sound is a kind of energy.

When we strike a drum, sound is produced. The sound is produced because the drum skin vibrates. This sound vibrates our eardrum and we hear it. Larger amounts of energy can produce louder sounds. If a drummer beats the drum with a lot of force, it will make a loud sound. We can conclude that:

Much energy = Loud sound

Less energy = Soft sound

Vibrations affect the volume of sounds. We can observe it on the surface of a deck speaker. When the volume is high, more vibrations can be seen by putting pieces of paper or empty capsules on the surface of the speaker. Loud volume sounds can be produced by strong vibrations. It shows that loud sound possesses more energy than the soft sound.



Fig.11.3: A drum can produce loud sounds.

Fix one end of the meter rod on the edge of the table with the help of screw.

- Press the free end of the meter rod gently. It will vibrate slowly and will produce a soft sound.



- Now push the ruler farther down and release. A louder sound is produced with a higher number of vibrations.



Whenever work is done on an object, energy is given to it. In this case the energy of your hand produces vibrations in the ruler. The ruler produces sound energy in exchange of your energy.

**Energy must always be added to an object to produce sound.**

## How Does Sound Travel?

When someone calls us from a distance, we hear the sound. It means sound travels. But sound needs a medium to travel all the time. The medium may be gas (air), liquid (water) or solid (metal).

Sound is a form of energy that spreads from its source in all directions. It is only possible when the vibrating particles hit each other and pass on the vibrations as sound. That is why sound energy needs a medium for its propagation. Sound energy cannot travel in vacuum due to the absence of any particles.

Sound also loses energy as it travels from one place to the other. Have you ever observed that a loud sound dies off after travelling for some distance? Have you ever observed that when your friend goes away from you, sometimes your call does not reach him? why?



Fig.11.4: Sound from the radio can travel through solids, liquids and gases.

Fig.11.5: Sound vibrations travel in air.



Is sound transmitted through wood, plastic, metal and cardboard? Can you hear a scratch through wood that you cannot hear through air? Use a tuning fork with different materials.



**Which material transmits sound better and louder?**

You can hear better through your bones. Try it!

Do some humming. Plug your ears with fingers during humming. The sound of hum hears better, when you plug your ears. Your bones are solid through which sound travels faster.



## Speed of Sound in Different Materials

We know that sound travels by passing on its vibrations to the particles of some medium. The speed of a sound depends on what kind of matter it is travelling through.

Air is made of gases. The particles in gases are farther apart than in liquids and solids. It takes longer for one gas particle to hit another and move the sound energy along. Particles in liquid are closer together. Water is a liquid. Sound travels more quickly in water than it does in air. Particles in solids are very close together than in liquids, so obviously sound travels the quickest in solids.

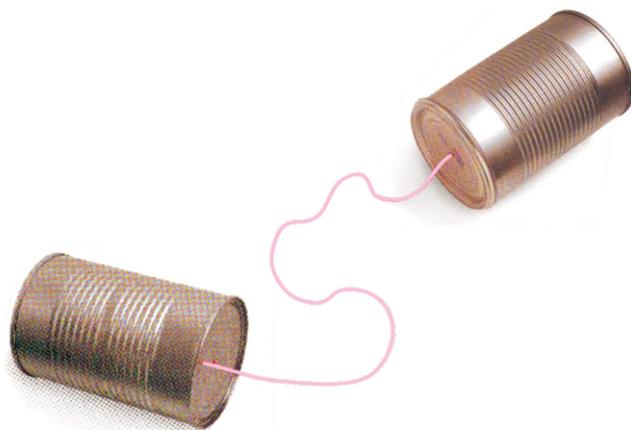


Fig.11.6: The particles of solids are very close to each other. You can use a tin-can telephone to talk to your friend because sound travels the quickest in solids.

Table 11.1: Speed of Sound in Gas, Liquid and Solid

Medium	Speed (metre per second)
Gas (air)	350
Liquid (water)	1,500
Solid (steel)	6,000

Hit two spoons together in air and then in water. Listen the sounds carefully in each case. Which transmits sound more efficiently, air or water?





## How does Human Ear Receive Sound?

We have studied the structure of human ear (Fig.11.7) in chapter 2. Here we shall see how it works.

The outer part (pinna) of the human ear directs sounds into the ear canal. Inside the ear canal, the sound waves hit the eardrum. The sound waves make the eardrum vibrate. The eardrum causes three tiny bones in the middle ear to vibrate. Because of their shapes, the bones are named the hammer, the stirrup, and the anvil. Then the vibrations move into the cochlea in the inner ear.

The cochlea is a snail-shaped organ which is filled with a liquid. When the liquid in the cochlea starts to vibrate, tiny hairs in the cochlea move. They convert the vibrations into signals. These signals of sound travel along the auditory nerve to the brain.

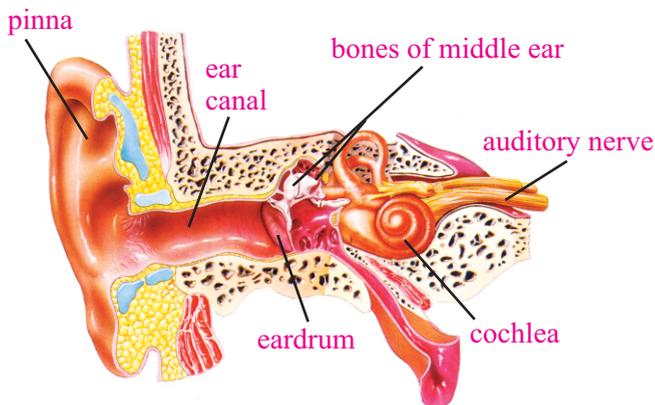


Fig.11.7: Internal structure of human ear



Ear protectors

### Protect Your Ears

The ear drum of your ear is very delicate and sensitive. It can easily be damaged. If there is an injury in the ear drum of your ear, you may become deaf.

- ◆ Don't enter any object into the ear. It may be dangerous.
- ◆ Listening to noise over and over for a long time can cause hearing loss.
- ◆ Wear ear protectors at noisy places.

1. All sounds are produced by vibrating bodies.
2. Sound is a form of energy.
3. Larger amount of energy can produce louder sounds.
4. Sound needs a material medium to travel.
5. Sound travels fastest through solids followed by liquids and gases.
6. Ears receive sound waves, convert them into signals and send them to the brain.
7. Very loud sound or any injury in the ear can make you deaf.

**1. Write proper term/word against each statement.**

- i. Sound moves the quickest through it \_\_\_\_\_
- ii. Speed of sound in it is 350 metres per second \_\_\_\_\_
- iii. Carries signals of sound to the brain \_\_\_\_\_
- iv. Back and forth movement \_\_\_\_\_

**2. Circle the letter of the best answer.**

- i. Sound waves travel most quickly through:  
(a) solids (b) gases  
(c) air (d) liquids
- ii. When does our body use more energy?  
(a) when we speak gently (b) when we talk to our friend  
(c) when we cry over others (d) when we talk to our mother
- iii. The speed of sound in steel is:  
(a) 350 metre per second (b) 1,500 metre per second  
(c) 2,100 metre per second (d) 6,000 metre per second
- iv. Sound travels the slowest in:  
(a) water (b) steel  
(c) copper (d) air
- v. Which group of people is unable to hear one another?  
(a) a group of mountaineers on K-2 (b) a group of tourists in a desert  
(c) a group of astronauts on the Moon (d) a group of people in a closed room

**3. Answer the following questions in detail.**

- i. Prove that sound is a form of energy.
- ii. How does sound travel?
- iii. How do we hear sound?

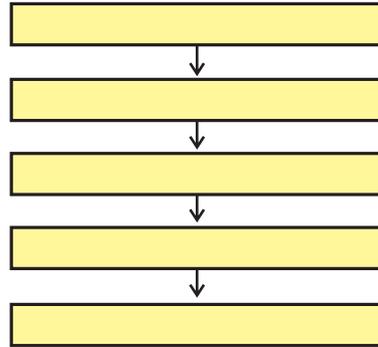
**4. Extend your thinking.**

- i. What happens if you sprinkle paper pieces on a drumhead and then hit the drumstick?
- ii. Could sound from a radio travel through a room with no air? Explain.
- iii. Does sound move faster through the ear canal or through the tiny bones in the middle ear?
- iv. Explain how covering the ears can keep a person from hearing a sound?
- v. How can sounds be harmful and helpful?
- vi. Why is there no sound heard in vacuum?

- vii. A bird sitting in a tree hears the chirping of another bird. A whale hears the songlike sound made by another whale swimming near it. Which sound travels faster, the bird's chirping or the whale's singing? Explain.

5. **Concept Map**

Write following words in order of how you hear sound:  
hammer, cochlea, brain, eardrum, ear canal



- 1 Mark a round hole on top of a shoe box and cut it. Place two wooden wedges at the ends of the hole to make the bridges of the stringed musical instrument like zither. Stretch rubber bands of different widths around the box. Pluck the strings to hear a musical note which can be changed by tightening the bands with a drawing pin.
- 2 Tie a metal object, such as a wire hanger or a spoon, to the center of a piece of string. Wrap each of the two ends of the string around one finger on each hand. Gently place the fingers holding the string in your ears. Let the object swing until it strikes against the edge of a chair or table and listen to the sound. Listen to the sound made by the collisions when your fingers are not in your ears. Do sound travel better through air or through the string?

Many more people want to fly in and out of Lahore Airport. The airport needs to build another runway to handle more airplanes. This would bring money and jobs to the local people. Neighbours of the airport object. The added noise might break their windows and damage their hearing. The airport manager agrees that there will be more noise. But he says it will only last a few hours each day. He has to think about the whole city, not just those who live near the airport. The city government will buy the homes of people who want to move away. What are the arguments for a new runway? What are the arguments against the runway?

**Computer Links**

- [www.historyforkids.org/scienceforkids/physics/sound/](http://www.historyforkids.org/scienceforkids/physics/sound/)
- [http://scifiles.larc.nasa.gov/text/kids/D\\_Lab/acts\\_sound.html](http://scifiles.larc.nasa.gov/text/kids/D_Lab/acts_sound.html)