SOUND

Chapter 4

After a scorching summer, the sound of thunder and the black monsoon clouds bring joy to the heart. The delightful chirping of birds in the early morning brightens our day. The sweet, lilting notes of a flute are soothing and peaceful. But not all sounds are enjoyable. A loud grating noise irritates you and gives you a headache. You hear different sounds every day. Some are shrill and some are deep. You may like some sounds and dislike others.

Have you ever wondered how sound is produced? Why are some sounds high pitched and others low pitched? Let us do some experiments to find answers to these and other questions.

Experiment 1

How is sound produced?

Make sure that your school bell hangs freely and does not touch anything else. Strike the bell with a hammer.

Did the bell stop ringing soon after it was struck by the hammer? (1)

Gently touch the bell with a finger while it is ringing.

Did you feel it vibrating? (2)

Ring the bell again and grasp it tightly with both hands.

When you held it firmly, did the bell continue to ring as before? (3)

Touch the bell again after it has stopped ringing.

Did you still feel it vibrating like it did earlier? (4)

Experiment 2

Strike the rim of a plate lightly with a spoon or stick.

Did you hear a sound? (5)

Strike the plate again, touch its rim gently and observe what happens.

Did you feel the same sensation you felt when you touched the ringing bell?

Strike the plate and then clutch it tightly so that the sound stops. Now touch the plate gently again.

Do you still feel any vibrations? (6)

How were the vibrations affected when you clutched the plate tightly? (7)

Under what conditions does a plate produce a sound? Think carefully before answering. (8)

Experiment 3

Buy a bamboo whistle (Figure 1) from a vendor and examine its parts.

Figure 1

Blow the whistle. Touch it gently while you blow.

What did you feel? (9)

Which part of the whistle vibrates? (10)

Make your own whistle

Take a strip of paper about 13 cm long and 7 cm wide. Fold it as shown in Figure 2a and make a hole in its centre. On opening the folds, the paper strip should look like Figure 2b.

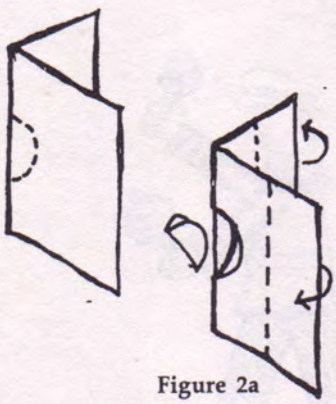


Figure 2a

Figure 2b

Figure 2c

Hold the strip as shown in Figure 2c and blow into the hole. What happens?

The vibrations of your voice

Ask a friend to say aaaaah and place your fingers gently against his throat.

Did you feel his throat vibrating? (11)

Our throats have special muscles called vocal chords. When we speak, they vibrate.

You observed several methods of producing sound in the experiments you have done till now.

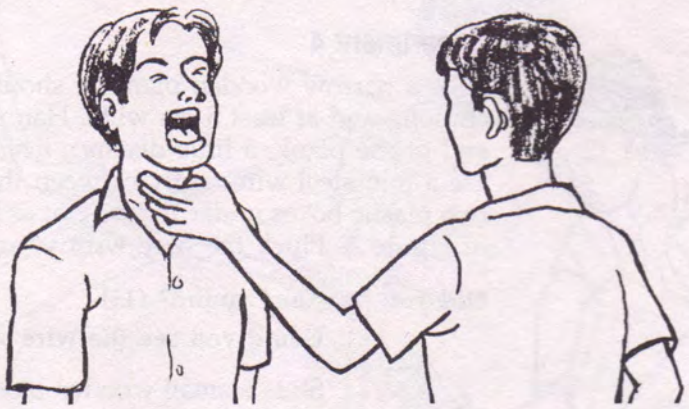


Figure 3

In each method, sound was produced by a specific process. What is this process? (12)

In which methods did you actually see this process? In which methods did you only feel it by touch? Record your observations in a table. (13)

You may have seen many different instruments that produce sound - harmonium, *tabla*, *dholak*, cow bell, etc.

Play these instruments and carefully observe what happens. Touch them while they are producing a sound.

On the basis of your answers to Question 13, divide these instruments into two groups and list their names in the table. (14)

You may have blown into a pen cap or a small bottle to produce a whistling sound. Did you notice any of its parts vibrating?

Whistles produce vibrations in the air and these vibrations are the sound we hear. There are many instruments in which sound is produced by the vibration of air. Some examples are a flute, scout's whistle, *shehnai*, etc.

You hear many sounds every day - the drone of a mosquito, the buzz of a fly, the beat of a drum, birds singing, frogs croaking, the rustle of leaves, the chirping of crickets, etc. These sounds are produced by making something vibrate. Try and find out which part vibrates in each case to produce these sounds.

Low and high pitched sounds

A woman's voice is generally pitched higher than a man's. The mooing of a cow is low pitched while the bleating of a goat is high pitched. A *dholak* gives out a higher pitched sound from one side and a lower pitched sound from the other. In a harmonium, the keys on the right side produce high pitched notes while the ones on the left produce low pitched notes.

Let us find out how high and low pitched sounds are produced.

Bear one thing in mind while performing the following experiments. People often confuse high and low **pitch** with how loud or soft a sound is. A low pitched sound can either be loud or soft. Similarly, a high pitched sound can also be loud or soft.

Experiment 4

Take a narrow wooden plank. It should be 80 cm to 90 cm long and at least 5 cm wide. Hammer a nail at each end of the plank, a little distance inside from the edge. Tie a thin steel wire tautly between the two nails. Slide two plastic boxes under the wire at either end as shown in Figure 4. Pluck the wire with your finger.

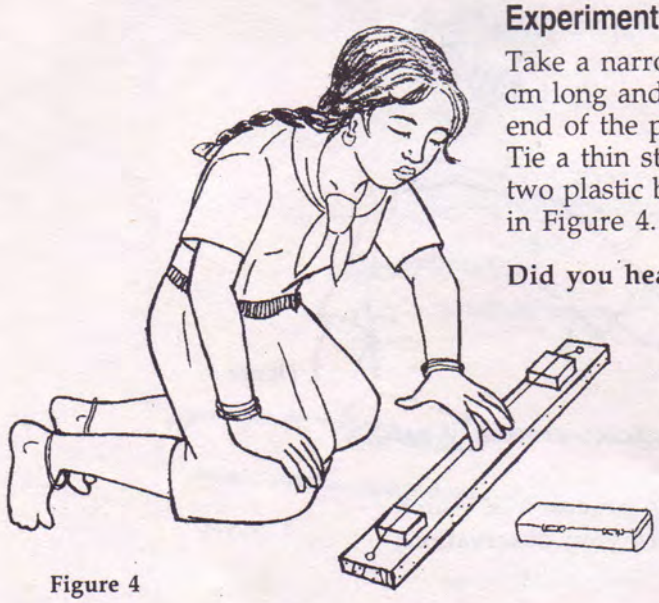


Figure 4

Did you hear any sound? (15)

Could you see the wire vibrating? (16)

Slide a small wooden block over one of the plastic boxes (Figure 5). Ensure that the wire does not become loose and that its length between the two blocks does not change.

How did the block affect the tension of the wire? (17)

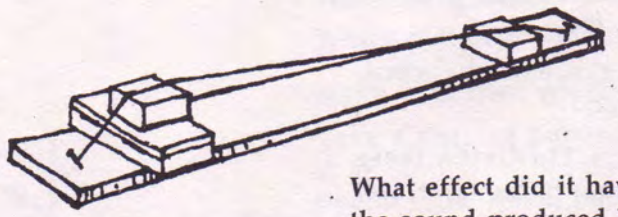


Figure 5

Pluck the wire again with your finger. Watch it carefully and listen to the sound it produces.

What effect did the block have on the vibrations produced in the wire? (18)

What effect did it have on the sound produced? Was the pitch of the sound produced higher or lower than before? (19)

Can you now suggest a relationship between the tension of the wire, the rate at which it vibrates and the sound it produces? (20)

Experiment 5

Length and frequency

Place a metre scale on the edge of a table as shown in Figure 6. About 95 cm of the scale should project out beyond the table's edge. With both hands, press down on the end of the scale which is on the table. It would be even better if you can clamp this end down.

Ask a friend to gently press the projecting end of the scale and release it.

Does it make a rattling sound?

If it does, that means you are not pressing it down at the correct point. Adjust your hands to the point where the rattling stops.

When you get the right position, ask your friend to press the scale down again and release it.

Did the scale vibrate? (21)

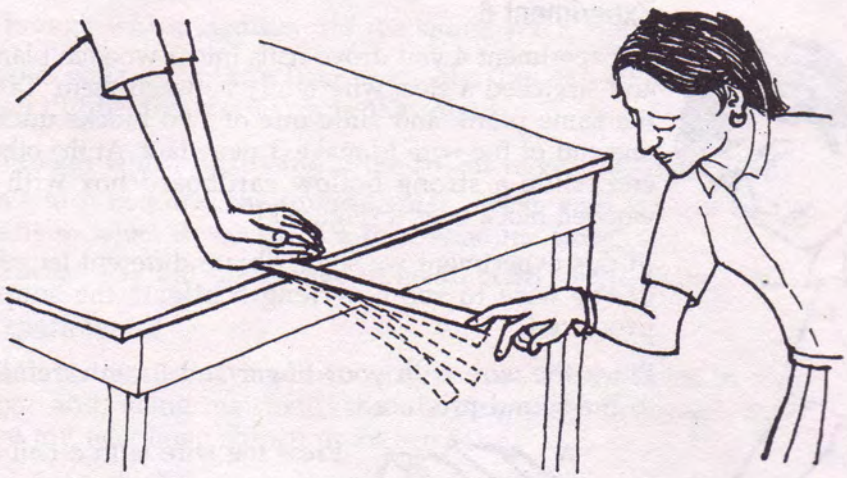


Figure 6

The **frequency** of any object is related to the number of vibrations it makes in a given interval of time. More precisely, the frequency of any vibrating object is defined as the number of oscillations it makes in one second. By one **oscillation** we mean one complete to and fro motion of the vibrating object.

Touch the vibrating scale at a point near the edge of the table.

What did you feel? (22)

Now move the scale 10 cm inwards onto the table.

Set the scale vibrating again and see if there is any difference in the vibrations this time.

What difference is there in the vibrations compared to the previous position? (23)

Keep reducing the length of the vibrating part of the scale 10 cm at a time. Vibrate the scale at each length and observe the vibrations carefully. Also, get a feel of the frequency of oscillations by gently touching the scale near the edge of the table. As the length of the vibrating part decreases, your friend will have to apply more pressure to make the scale vibrate.

When the length of the vibrating portion of the scale is reduced, what effect does it have on the vibrations produced? (24)

Was any sound produced in any of the positions of the scale you experimented with? (25)

You may have to place your ear close to the scale to make out whether it is producing a sound or not.

If you did hear a sound, what was the length of the vibrating portion of the scale? (26)

Were you able to see the vibrations when the length of the scale projecting from the table was about 15 cm? (27)

If you could not, what could be the reason? (28)

Experiment 6

In Experiment 4 you drove nails into a wooden plank and stretched a steel wire tautly between them. Take the same plank and slide one or two blocks under one end of the wire to make it more taut. At the other end, slide a strong hollow cardboard box with a wooden block over it (Figure 7).

In this experiment we shall vibrate different lengths of the wire to see how length affects the sound produced.

Pluck the wire with your finger and listen carefully to the sound produced.

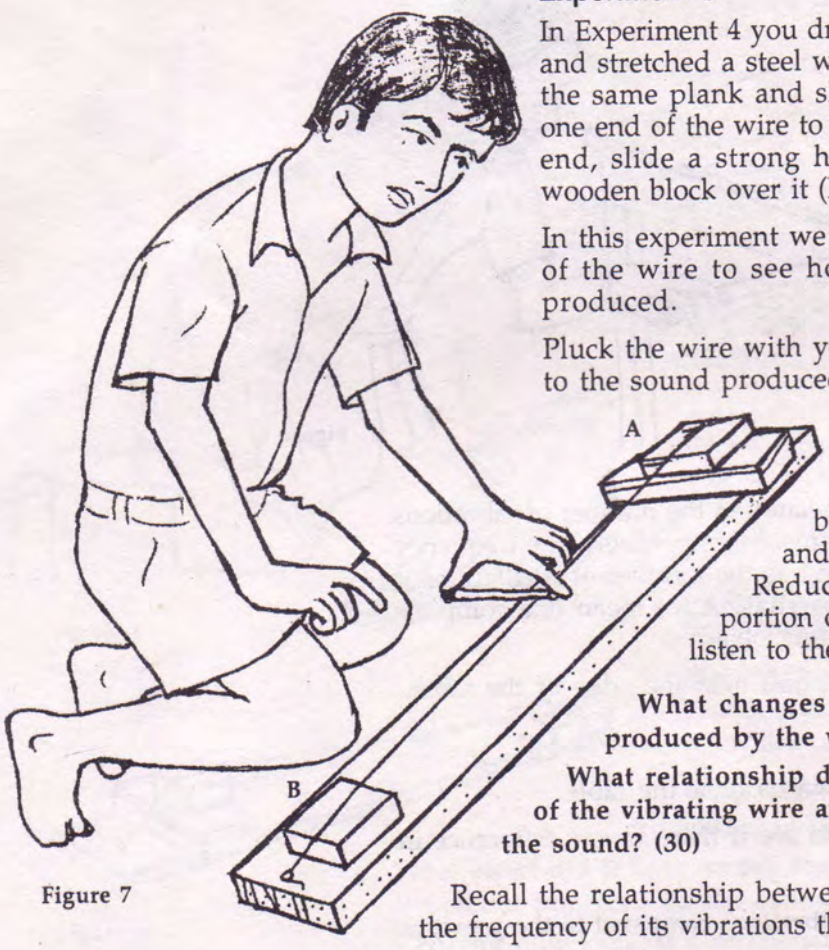


Figure 7

Press the wire with a nail at a distance of about 5 cm from point A. Pluck the wire between the nail and point B and listen to the sound produced. Reduce the length of the vibrating portion of the wire 5 cm at a time and listen to the sound produced in each case.

What changes did you notice in the sound produced by the wire? (29)

What relationship do you see between the length of the vibrating wire and the pitch - low or high - of the sound? (30)

Recall the relationship between the length of the scale and the frequency of its vibrations that you noted in Experiment 5.

Based on your observations so far, what is the relationship between the length of the wire, the frequency of oscillations and the pitch, low or high, of the sound produced? (31)

An object must vibrate to produce sound. These vibrations cause the surrounding air particles to vibrate, which in turn causes our eardrums to vibrate. That is how we hear sound. There must be something to carry the vibrations of an object to our ears. This something is called a medium. When we talk to each other or listen to the radio or hear the school bell, it is air which acts

as the medium between our ears and the vibrating object. But sounds can reach us through other mediums as well. Let us do some experiments with different mediums.

Experiment 7

Sound and the medium

Put your ear close to the surface of a table. Tap the table gently with your finger at a distance of about 30 cm to 40 cm from your ear. Listen carefully.

Did you hear a sound? (32)

Through which medium did the sound reach you? (33)

Raise your ear a little from the table. Tap the table again, like you did before, and listen to the sound.

Through which medium did the sound travel this time? (34)

In which case was the sound louder - when your ear was on the table or when it was lifted a little from the table? (35)

In what way did the change in medium affect the sound? (36)

Experiment 8

Take the inner trays of two matchboxes. Pierce holes in their base and, using matchsticks and a long piece of thread, make the toy telephone shown in Figure 8.

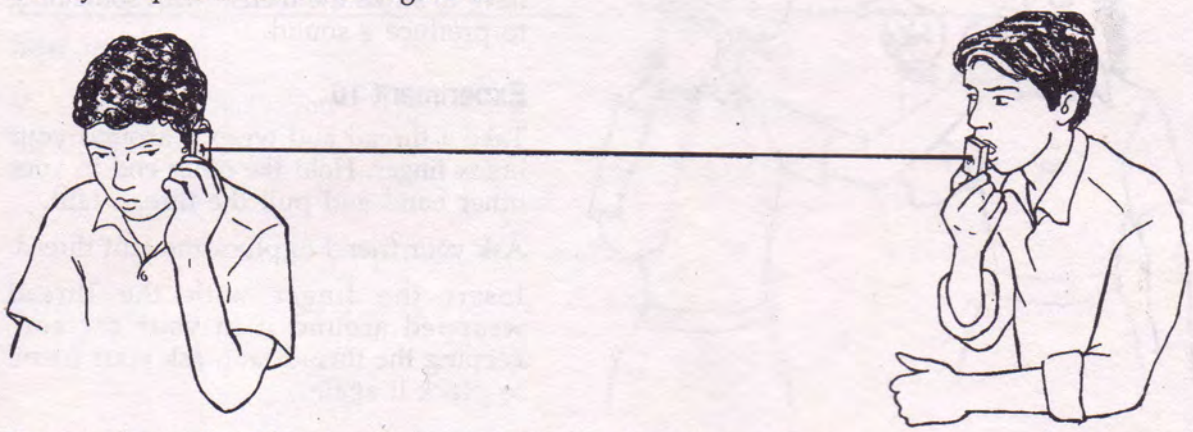


Figure 8

Two students should hold the trays with the thread stretched taut between them. One should say something softly into his tray while the other holds his tray close to his ear and tries to listen to what is being said. A third student should stand nearby and try to hear what is being said without the help of the toy telephone.

Did both students hear what was said?

If not, then who heard what was said?

Why did this happen? (37)

What arrangement can you make if more than one student wishes to hear what is being said on the matchbox telephone?

Devise an experiment

Try to devise an experiment to hear sound that travels through water. If possible, perform the experiment and discuss your results in class.

Write a summary of your discussion in your exercise book. (38)

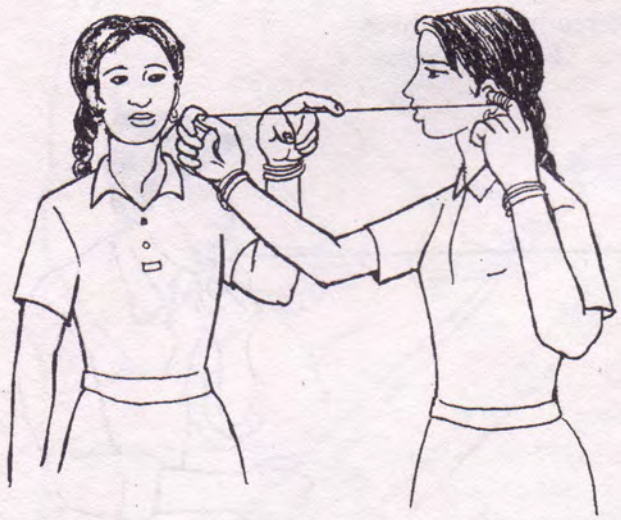
Experiment 9

Take two metal spoons. Tie them in the middle of a 2-metre-long thread. Keep a distance of about 2 cm between the two spoons. Wrap the ends of the thread around your index fingers and insert your fingers in your ears. Swing the thread so that the spoons bang against each other.

Did you hear anything? (39)

Remove your fingers from your ears and swing the spoons again so that they strike each other.

Was the sound the same as before? If not, why was it different? (40)



You can perform this experiment with a tumbler, bowl or other utensil. You will have to strike the utensil with something to produce a sound.

Experiment 10

Take a thread and wrap it around your index finger. Hold the other end in your other hand and pull the thread taut.

Ask your friend to pluck the taut thread.

Insert the finger with the thread wrapped around it in your ear and, keeping the thread taut, ask your friend to pluck it again.

What was the difference in the sound produced in both cases? (41)

You have learned many things about sound in this chapter - how sound is produced, the relationship between frequency and pitch, the role a medium plays in transmitting sound, etc.

We hear sounds only because of our ears. They are sensitive organs so we can hear even soft sounds. But people who live in a noisy environment, like those living in big cities or working in a factory, become less sensitive to sound over a period of time. When we are surrounded by loud noises all the time they affect our ears and also cause other physical and mental problems.

Extremely loud noises, such as exploding crackers, can damage

your eardrums. You could also damage your eardrum if you insert a pointed or sharp object into your ear. You should be careful and avoid doing such things.

Questions for revision

1. **When a utensil falls down it makes a loud clanging noise. But the moment you pick it up and hold it in your hands, the sound stops. Why?**
2. **Why doesn't a cycle bell ring properly if you cover it with your palm?**
3. **Two wires are stretched taut on a wooden plank. They are of different lengths but the tension of both wires is the same. If they are plucked, can you identify which is the longer and which is the shorter wire by the sounds they produce?**
4. **A steel wire is fixed to a nail. It has a 10 kg weight attached to it. The wire produces a sound when it is made to vibrate. What must you do to produce a sound of a higher pitch?**
5. **Take an empty test tube. Blow across its mouth to produce a whistling sound. Add 2 ml of water to the test tube and blow again. Keep adding 2 ml of water each time and blowing. What difference does the level of water make to the sound produced? Can you explain why this happens?**

New words

Vibration Oscillation Frequency Pitch Tension
Medium

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