GAMES WITH AIR

Chapter 11

The hot air of the arid summer months parches your throat and dries your skin. Then comes the monsoon and its moisture-laden wind is soothing. In winter, the breeze chills you to the bone. Bicycling in the direction the wind blows is easy, but try bicycling against the wind and you'll find yourself huffing and puffing. If the wind gets stronger, it raises a storm. Dust and gravel fill the air and trees are uprooted.

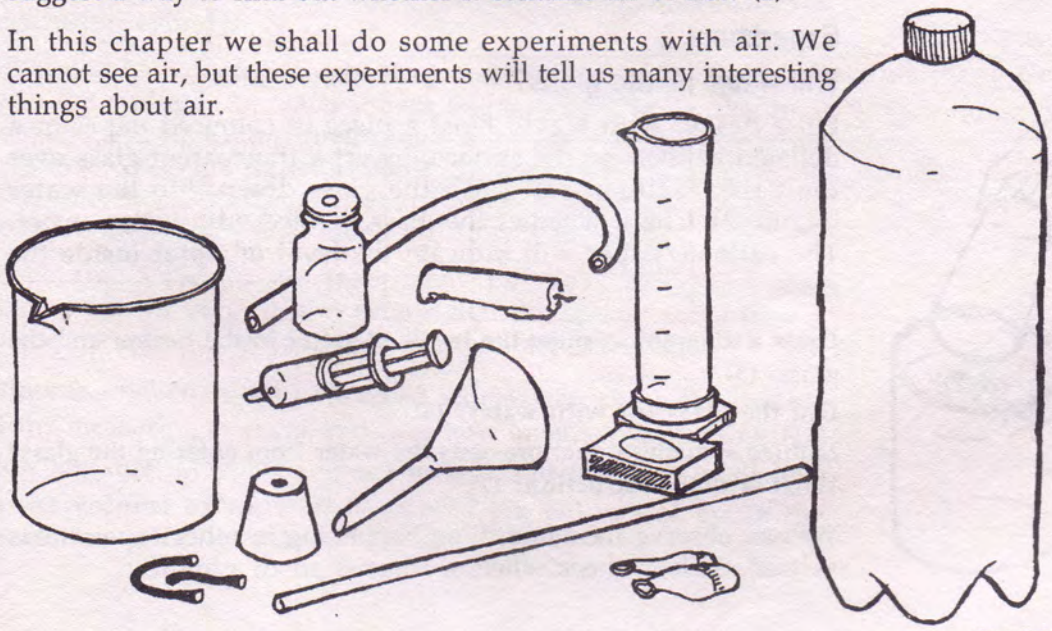
Yes, you must have felt and experienced the presence of air in many different ways.

List the ways in which you can tell whether air is present around us. (1)

Suppose there is no breeze blowing and everything is still. How can you tell whether air is present or not, or where it is? Under a tree on which not even a leaf stirs? In a room? In an empty glass? In a closed bottle? In a glass tube?

Do you think an empty bottle or glass contains air? Can you suggest a way to find out whether it contains air or not? (2)

In this chapter we shall do some experiments with air. We cannot see air, but these experiments will tell us many interesting things about air.



Experiment 1

Where air is present and where it is not:

If you dip a glass in water, will it fill with water? You may think this is a silly question because you usually fill your glass by dipping it in a vessel of water. But try filling a glass with water by immersing it in the way shown below.

Stuff some paper in the bottom of the glass (Figure 1). Invert the glass and immerse it in a bucket of water. The glass should be completely under water.

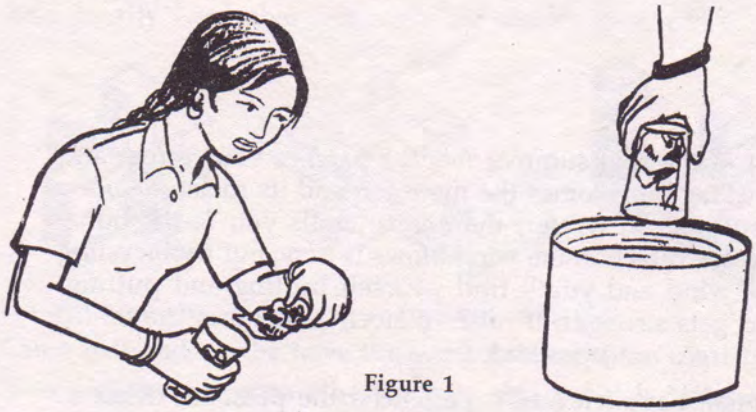


Figure 1

Did the paper in the glass get wet or not? Take a guess before actually checking. (3)

Take the glass out of the water and, keeping it inverted, check whether you guessed correctly.

What would happen if you tilt the glass while immersing it in water?

Try the experiment and write what you observe in your own words. (4)

Experiment 2

Will water fill the glass?

Fill a beaker with water. Float a piece of coloured paper or a deflated balloon on the surface. Invert a transparent glass over the paper/balloon and push the glass down into the water (Figure 2). Check whether the glass is filled with water or not. The balloon/paper will indicate the level of water inside the glass.

Figure 2

Draw a diagram to show the levels of water in the beaker and the glass. (5)

Did the glass fill with water? (6)

Is there something that prevents the water from entering the glass? What is that obstruction? (7)

We can observe the same thing happening in other experiments as well. So let's check whether there is air in a bottle.

Experiment 3

Fill a bottle with water

Fill a bucket with water. Take a narrow-mouthed bottle and immerse it in the bucket till it fills with water.

Did something come out of the bottle when water entered it? How do you know whether something came out or not? (8)

Which property of air did you learn about from your observations in Experiments 1 to 3? (9)

Would it be correct to say that a glass or bottle that we think is empty is actually full of air? (10)

The volume of air

If air is everywhere, can you suggest a way to measure its volume? For example, if you want to find out how much air there is in an injection bottle, how would you find out?

If you can think of a way to measure the volume of air, discuss it in class. Use your method to find out how much air the injection bottle contains.

The following experiment gives one way of measuring the volume of air.

Experiment 4

Make two holes in the rubber stopper of a large injection bottle. Insert two empty refill pieces through the holes. Attach valve tubes to the upper ends of the refills and set up the arrangement shown in Figure 3.

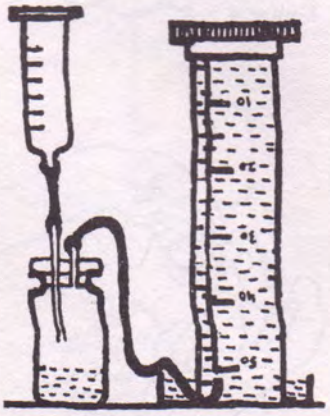


Figure 3

Attach an inverted syringe to the free end of one of the valve tubes. Take a measuring cylinder and fill it with water. Invert the measuring cylinder in a plate of water without letting the water spill out. Insert the free end of the other valve tube into the measuring cylinder.

What you have to do now is pump water into the injection bottle with the syringe. As water enters the injection bottle, the air it contains is forced out through the other refill into the measuring cylinder. When the injection bottle is filled with water, all its air goes into the measuring cylinder. You can check the measuring cylinder to find out how much air it contains.

So go ahead and do the experiment. Fill water in the injection bottle with the syringe. But ensure that the second valve tube is inside the measuring cylinder while you are doing so.

When the injection bottle is filled with water, check the reading of the measuring cylinder and note how much air it contains. (11)

Now measure the volume of the water in the injection bottle. (12)

Is the volume of water the same as the volume of air in the measuring cylinder? (13)

On the basis of this experiment, can you suggest a simple way to measure the volume of air present in a utensil? (14)

Is the volume of air constant?

In Experiment 4 you measured the volume of air. Is this volume constant or can it change? Let us find out by doing some experiments.

Figure 4

Heat air and see what happens

If you pump a lot of air into the tyre of a bicycle and leave the bicycle out in the sun for a long time, the tube in the tyre sometimes bursts.

Why does this happen? Let us heat air to try and understand what happens.

Experiment 5

Attach a large balloon to the mouth of a half-litre plastic bottle (Figure 4). Be careful not to squash the bottle while doing so. Place the bottle in the sun. Inspect it after 4 to 5 minutes.

What happened to the balloon? (15)

Why did this happen? (16)

Cool the bottle by placing it in the shade. Inspect it again after 5 minutes.

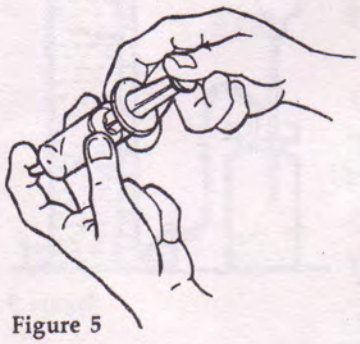


Figure 5

What is the condition of the balloon now? (17)

Why did this happen? (18)

Can you now explain why a bicycle tube sometimes bursts in summer? (19)

Experiment 6

Take a syringe and draw out its **plunger** to the limit.

Is the syringe filled with air? (20)

What is the volume of this air? (21)

Close the nozzle of the syringe with a finger and press the piston. (Figure 5)

Were you able to press the piston? (22)

Did you feel a pressure on your finger while doing so? (23)

What happened to the volume of air after you pressed the piston? (24)

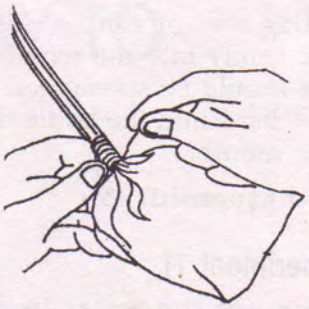
Did the amount of air in the syringe decrease or did only its volume decrease? (25)

Fill the syringe with water and repeat the experiment.

Could you press the piston down when the syringe was filled with water? (26)

You saw a difference in one property of air and water in this experiment. What is that property? (27)

Can the volume of air be reduced by applying pressure? (28)



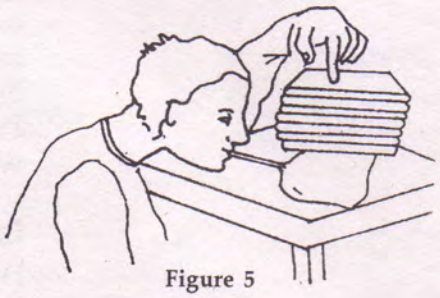


Figure 5

Air pressure

In Experiment 6 , you felt a slight **pressure** on your finger when you closed the nozzle of the syringe and pressed the piston. What caused this pressure? Was the air in the syringe exerting the pressure?

Let us do some experiments on air pressure to find an answer to this question.

Experiment 7

Take a thick polythene packet - a milk packet would be ideal. Insert a glass tube or an old ball-point pen into the packet, as shown in Figure 5, and tie its mouth tightly with thread. Place the packet on a table and put a couple of books on top of it. Blow air into the packet through the tube.

What happened? Why did this happen? (29)

Experiment 8

Take a large plastic bottle and a two-holed rubber cork that fits firmly into its mouth. Insert two glass tubes into the two holes of the cork. The glass tubes should fit tightly in the holes. Tie a coloured balloon to the lower end of one of the glass tubes.

Figure 6

Close the mouth of the bottle with the cork and seal it with sealing wax to make the bottle airtight. The balloon should be inside the bottle as shown in Figure 6.

Now suck air out of the bottle through the tube that doesn't have a balloon attached to it.

What happened to the balloon? (30)

Why do you think this happened? (31)

Figure 7

Experiment 9

Take a glass tube and fill it three fourths with water. Close one end with your thumb and dip the other end into a beaker of water (Figure 7).

Did the water in the tube remain inside or did it flow into the beaker? (32)

Remove your thumb from the top end of the tube.

What happened? (33)

Experiment 10

Fill a half-litre plastic bottle one third with water. Select a one-holed cork that fits firmly into its mouth. Insert a glass tube through the hole in the cork. Seal the glass tube in the cork with

Figure 8

sealing wax or candle wax to make the cork airtight. Fit the cork firmly into the mouth of the bottle. The lower end of the tube should be submerged in the water in the bottle (Figure 8). Blow hard into the bottle through the tube and quickly remove your mouth.

What happened? (34)

Experiment 11

Drain out the water from the bottle used in the previous experiment and refix the cork tightly. Squeeze the bottle gently with both hands and then squash it a little. But take care not to break it. Invert the slightly crushed bottle and dip the tube into a beaker of water. Relax the pressure of your palms on the bottle.

What happened? (35)

Questions for revision

1. **How much air does a bucket contain? Suggest a way to measure the amount of air.**
2. **Take an injection bottle. Insert a piece of a refill into its rubber cap and fix the cap on the bottle. Put a drop of water on top of the refill or fill a little water in it. Hold the bottle tightly in your palm. What happened to the drop of water? Why did this happen?**
3. **Take a syringe like the one used in Experiment 6. Pull its plunger to the halfway mark. Close its nozzle with your thumb and try to pull the plunger to its outer limit. Were you able to pull the plunger easily? What did you feel on your thumb? What happens when you leave the plunger after pulling it?**
4. **You did several experiments with air in this chapter. Fill in the table below on the basis of your observations:**

Table: Properties of air

Experiment No	Property of air the experiment illustrates
1.	
2.	
3.	
4.	
5.	

New words

Pressure Plunger