

# 05

## MATTER AND ITS STATES

In this chapter, we will learn about:

- Introduction to three states of matter
- Effects of heat on solids, liquids and gases
- Mixing of materials
- Soluble and insoluble solids
- Separation of insoluble solids from water



**Figure 5.1: Variety of animals, plants, mountains, rivers, stars and different objects are examples of matter**

We see different things around us. Trees, flowers and animals are found everywhere in our surrounding. We also see different objects in our homes and schools.

There are mountains, rivers, stars and the Moon. We feel air around us.

All these things are made up of matter. We can define matter as:

Anything which has mass and occupies space is called matter.

## SHAPE AND VOLUME

Some things are big and some are small. A watermelon is bigger than a lemon. Bigger things occupy more space than smaller things. **The space occupied by an object is called its volume.** Thus, a watermelon has more volume than a lemon (Figure 5.2).

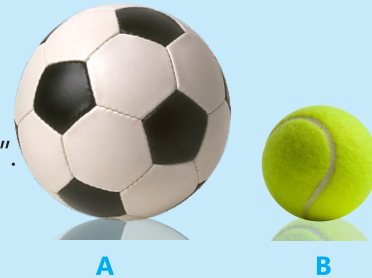


Figure 5.2



### Activity 5.1

- Take two balls (one big and one small).
- Place them side by side.
- Label the big ball "A" and the small ball "B".



**Q 1:** Which of the two balls (A or B) has less volume?

**Q 2:** Which of the two balls (A or B) has more amount of matter?

**Bigger the size of an object larger is its volume.**

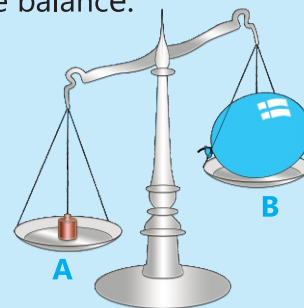
## MASS

The amount of matter in an object is called its mass.



### Activity 5.2

- Observe the objects placed in two pans of the balance.

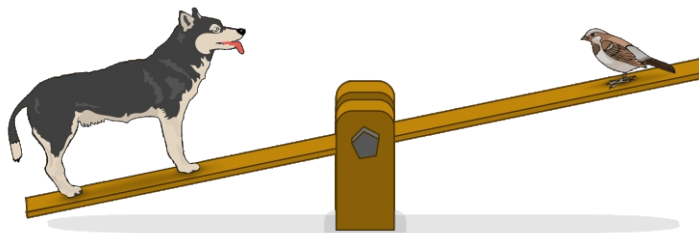
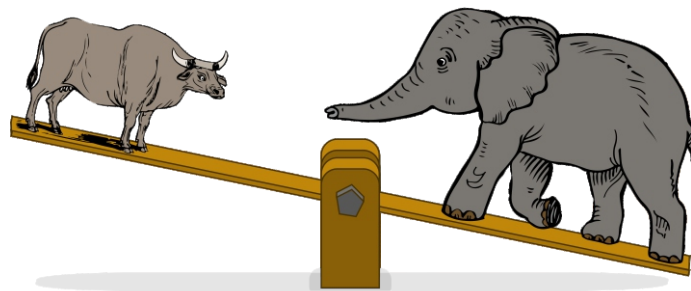
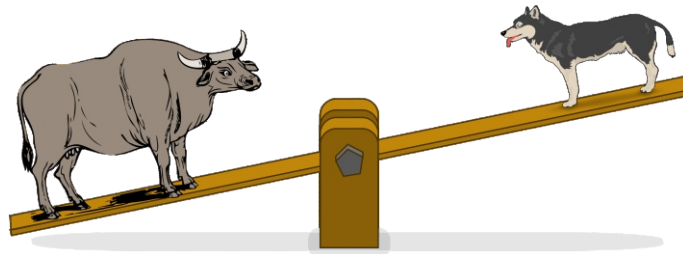


**Q1:** Which of the two shows greater mass?

**Q2:** Which of the two shows less volume?

## ASSESSMENT

- Tick the object showing less mass.



## THREE STATES OF MATTER

Matter exists in three physical states that are solids, liquids and gases.

### SOLIDS

A lot of things have fixed volume and fixed shape. Such things are called **solids**. Table, chair, book, brick wall, pencil, cup, car, wheat grains, sugar crystals, etc., are the examples of solids (Figure 5.3).



Figure 5.3: Solid Objects

## LIQUIDS

Many things have fixed volume but no fixed shape. They take the shape of the container in which they are contained. These things are called **liquids**. Water, oil, petrol, milk, fruit juices, honey, etc. are the examples of liquids (Figure 5.4).



Figure 5.4: Liquid Objects

## GASES

There are things which have neither fixed shape nor fixed volume. They spread out to fill the container (Figure 5.5). Such things are called **gases**. Air, smoke, oxygen, carbon dioxide, hydrogen, steam or vapours are the examples of gases.



Figure 5.5: Objects containing gas

The properties of solids, liquids and gases regarding their volumes and shapes can be observed through the activities given below.



### Activity 5.3

- Take a toy car, a small cup, an iron nail and a tub.
- Observe the shape and volume of toy car, cup and iron nail.
- Put all these things in the tub.



**Q1:** Is there any change in the shape and volume of any of the objects put in the tub?

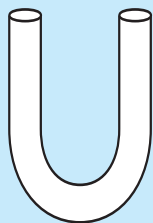
**Q2:** What do you conclude from this activity?

## Solids have fixed volume and fixed shape.



### Activity 5.4

- Take a test tube, a U-shaped tube, a plate and syringe



- Fill a syringe with water and empty it in the test tube.
- Again fill the syringe with water and empty it in the U-shaped tube.
- Fill the syringe once again with water and empty it in the plate.
- ❖ Observe the shape of the same amount of water added in the three containers.
- ❖ Observe the space occupied by water in the three containers.

**Q1: What is the volume of water in three containers? (same or different)**

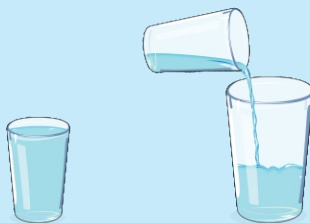
**Q2: What is the shape of water in three containers? (same or different)**

**Q3: What do you learn from this activity?**



### Activity 5.5

- Take two glasses, one big and one small.
- Fill the small glass with water.
- ❖ Observe the space occupied by water in the small glass.
- Pour the water of small glass into the big glass and note its level.



**Q1: Has water filled the whole space in the big glass?**

**Q2: What do you learn from this activity?**

We observe from activities 5.4 and 5.5 that the space that water takes up in a container depends upon the quantity of the water poured into the container. It means, liquid water has a fixed volume. We also observe that water changes its shape according to the shape of the container in which it is contained.

Water is liquid at room temperature. The other liquids also have fixed volume and change their shape according to the shape of the container in which they are contained.

**Thus, the liquids have fixed volume but no fixed shape.**

**Quiz: Name any three liquids.**



### Activity 5.6

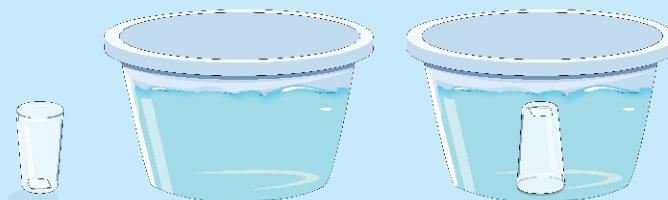
- Take three balloons having different shapes.
- Fill them with air and observe their shapes.

**Q1: What do you learn from this activity?**



### Activity 5.7

- Take a glass, a plastic tub, a piece of paper, a piece of cloth or a tissue paper and a gum stick.
- Paste the piece of paper at the bottom of the glass using the gum stick.
- Invert the glass in the tub filled with water as shown in the figure.



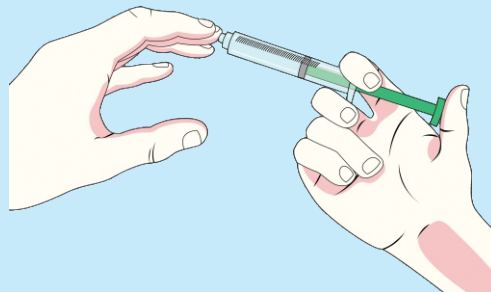
- Remove the glass out of water keeping it inverted and clean its wet sides with the help of a piece of cloth or tissue paper.
- Check the paper pasted at bottom of the glass. Is it wet or dry?
- If it is dry, explain why it remains dry?

**Q1: What do you learn from this activity?**



### Activity 5.8

- Take a syringe without needle.
- Pull the piston of the syringe. (The air will fill the syringe).
- Note the volume of air inside the syringe.
- Close the mouth of the syringe with your finger and push the piston.
- Do you notice any change in the volume of the air inside the syringe?
- Can gases be compressed?



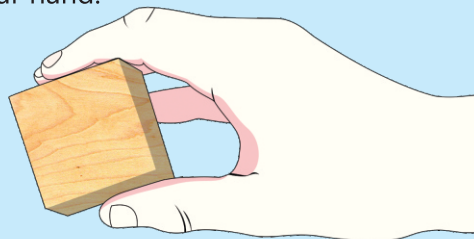
**Q1: What do you learn from this activity?**

**Gases have neither fixed volume nor fixed shape.**



### Activity 5.9

- Take a wooden block and press it in your hand.
- Can solids be compressed?

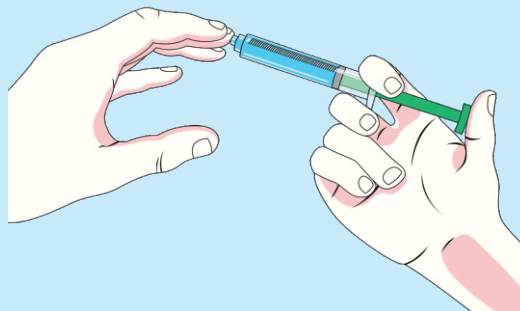


**Q1: What do you learn from this activity?**



### Activity 5.10

- Take a syringe without needle, fill it with water, close its mouth with your finger and push the piston inward.
- Can liquids be compressed?



**Q1: What do you learn from this activity?**

## Effect of Heat on Solids, Liquids and Gases

Things change their state on heating or cooling. Solids melt on heating and change into their liquid states. Liquids boil on heating and change into their gaseous states. Gases expand on heating and increase their pressure in the container. Liquids freeze on cooling and change into their solid states. Gases condense on cooling and change into their liquid states.



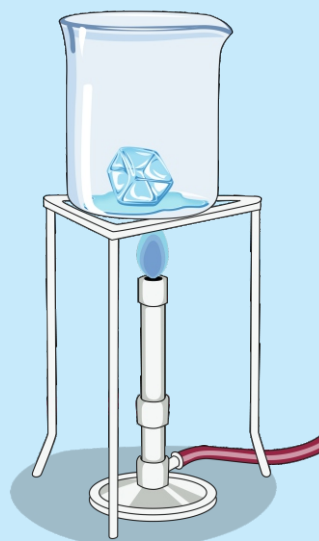
### Higher Order Thinking

- ❖ Matter consists of very small particles called atoms and molecules, etc. Molecules can exist independently. These particles of matter are always moving. The particles of solids do not change their position during their vibrations. That is why solids cannot flow or spread and have fixed shape and volume. The particles of liquids have rapid movements as compared to solids. They can change their position during the motion but remain in the liquid. That is why liquids can flow and change their shape but their volume remains fixed. The particles of gases are freely moving fast and spread out to occupy the whole available space. That is why gases have neither fixed shape nor fixed volume.



### Activity 5.11 (Demonstration by the teacher)

- Take an ice cube in a beaker or china dish and place it in front of the students.
- Ask students to observe the shape and volume of the ice cube and tell what its physical state is.
- Heat the ice cube by placing the china dish or beaker on a burner and ask students to observe what happens to the ice.
- Continue heating and ask students to observe what happens further.
- Ask students to write a note on what they have observed during the activity.







### Activity 5.12

- Fill a glass half with water and place it in your freezer.
- Observe after 5 to 6 hours what happened to the water in the freezer.
- Record your observation.

Physical state of water before freezing	Physical state of water after freezing

- Share what you have learnt from this activity with your friends and teacher next day.



### Activity 5.13

- Take a glass and fill it half with water.
- Add some crushed ice in it.
- Wipe the outer surface of the glass with a piece of cloth or tissue paper.
- ❖ After some time, you would notice tiny droplets of water along the outer surface of the glass.

**Q1: Where have these water droplets come from?**

**Q2: Does water in the glass pass out through the glass walls?**

**Q3: What do you learn from this activity?**



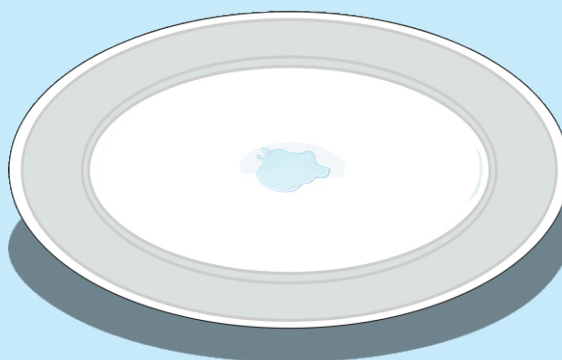


### Activity 5.14

- Take a little amount of water in a plate and place the plate in the sun.
- ❖ After some time, you would notice that the water disappears from the plate.

**Q1: Where has the water gone and why?**

**Q2: What do you learn from this activity?**



### Inquiry

- Have you ever noticed that the tyre of a bicycle burst in a hot summer day?
- If yes, why does it happen?

## MIXING OF MATERIALS

Most of the things we find in our surroundings are not in their pure form. They are the mixtures of different substances. For example, soil is the mixture of sand, rocks, moisture and air, etc. Milk is a mixture of different food groups, i.e., carbohydrates, proteins, vitamins, fats, salts and water, etc. Similarly, air is a mixture of different gases and water vapours.

**A mixture is a sample of matter containing two or more things mixed with each other.**

We mix many things to prepare salad. Can you name the things used in salad? We mix many things to make tea. Can you name the things used to make tea? Different things are used to prepare soda water. Can you tell the names of the things used in the preparation of soda water? Sweets, vegetable rice, lassi, yogurt, fruit juices etc., are the mixtures consisting of different substances (Figure 5.6).



Salad



Sweets



Vegetable Rice



Lassi



Tea



Soda Water

Figure 5.6: Examples of mixtures



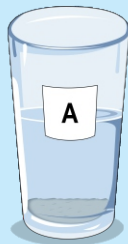
### Activity 5.15

- Name and collect different things which are mixed to prepare lemonade water.
- Prepare lemonade water and serve it to your friends.



### Activity 5.16

- Take a glass and fill it half with pure water.
- Add one teaspoonful of sand in it and stir the mixture well. Label the glass A.
- Take another glass half filled with pure water and add one teaspoonful of sugar in it and stir the mixture well. Label the glass B.
- Place the two glasses side by side, observe and compare the two mixtures.



Write the components of mixture A (----- and -----).

Write the components of mixture B (----- and -----).

**Q: What is the difference between the mixture A and B?**

## Separation of Insoluble Solids from Water

Insoluble solids can be separated from water by different methods. The two simplest ones are the decantation and filtration.

### Decantation

Decantation is a method for separating insoluble solids from water. In this method, water of the mixture is carefully poured into another container.



#### Activity 5.17

- Take a glass or beaker and fill it half with water.
- Add two spoonful of sand in it, stir the mixture and let the sand settle down at the bottom of the beaker.
- When the water above sand becomes clear, pour it carefully into another glass or beaker so that the sand is not disturbed.



### Filtration

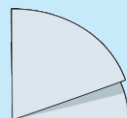
Filtration is another method of separating the insoluble components of a mixture. In this method, the mixture is passed through a porous sheet like a filter paper, a cotton cloth or a strainer. Separating tea leaves from tea using a strainer is a well-known example of filtration.



#### Activity 5.18

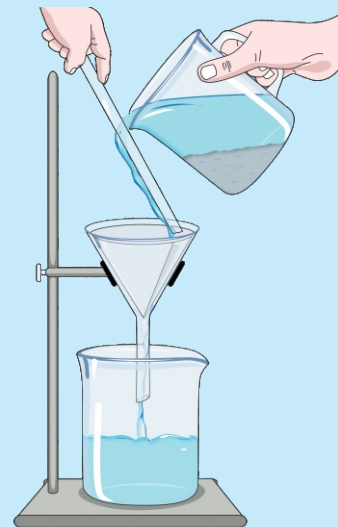
Prepare the mixture of sand and water in a beaker.

- Take a filter paper and fold it twice so that it gets four folds.
- Keep its three folds on one side and move one fold on the other side, so that it gets the shape of a funnel.



- Moisten the funnel from its inner side and fix the filter paper into it.
- Hang the glass funnel with the help of a stand and place an empty beaker below it.

- Pour the mixture of sand and water gently on the three fold side of the filter paper with the help of a glass rod.
- You will observe that the water passes through the pores of the filter paper and is collected in the beaker placed below while the sand particles are left behind on the filter paper.
- This is because the sand particles are relatively bigger in size than the pores in the filter paper.



## SCIENCE PROJECT

People cannot live without water. In case the clean water is not available, we must make the available water free from impurities before drinking. Let us work on a science project to make a water filter. This project can be done as a group activity.

### Part-I: Making a Water Filter (Demonstration by the teacher)

1. Take a plastic bottle, make a hole in its cap and cut the bottle into two halves with the help of your teacher.



2. Stuff the upper half of the bottle with cotton as shown in the figure.
3. Put some sand over the cotton.
4. Put some gravel over the sand.





5. Now the water filter is ready for use. Pour muddy water on the top of the filter. Collect water in a glass or beaker placed below the filter as shown in the figure.



### Part-II: Creating Awareness

- Conduct a campaign to create awareness about the importance of drinking clean water.
- Share the technique of making water filter with the people of your locality.

## KEY POINTS

- Anything which has mass and occupies space is called matter.
- Matter exists in three states, i.e., solid, liquid and gas.
- Solids have fixed shape and fixed volume.
- Liquids have fixed volume but no fixed shape.
- Gases have neither fixed shape nor fixed volume. They fill the whole container in which they are contained.
- Solids melt on heating and convert into their liquid states.
- Liquids boil on heating and convert into their gaseous states.
- Gases condense on cooling and convert into their liquid states.
- Liquids freeze on cooling and convert into their solid states.
- A sample of matter containing two or more substances mixed with each other is called mixture.

- Separation of an insoluble solid from its liquid mixture by pouring the liquid carefully into another container is called decantation.
- Separation of an insoluble solid from its liquid mixture by passing the mixture through a filter paper is called filtration.

## GLOSSARY

<b>Volume:</b>	The space occupied by an object
<b>Mass:</b>	The amount of matter in an object
<b>Melting:</b>	Conversion of a solid object into its liquid state by heating
<b>Freezing:</b>	Conversion of a liquid into its solid state by cooling

### EXERCISE

#### 5.1 Encircle the correct option.

- (i) A state of matter having a fixed volume but no fixed shape:
- a. solid                      b. liquid  
c. gas                         d. none of these
- (ii) The process in which a liquid turns into its solid state:
- a. melting                    b. freezing  
c. boiling                    d. condensation
- (iii) Tomatoes from the salad can be separated by:
- a. picking                    b. decantation  
c. filtration                  d. heating
- (iv) The quantity of water in the air increases in:
- a. summer                    b. winter  
c. spring                     d. rainy season
- (v) Which of the following is not a matter?
- a. animals                    b. plants  
c. air                         d. sound

- (vi) Matter that spreads out to occupy the whole available space:
- a. ice cream                      b. honey  
c. air                                  d. water
- (vii) Which state of matter can be poured from one container to another?
- a. solid                              b. liquid  
c. gas                                d. both solid and gas
- (viii) Both the components of a mixture have no fixed shape:
- a. sand in water                  b. air in sand  
c. air in water                      d. sugar in salt
- (ix) The mixture that can be separated by filtration:
- a. sugar in water                  b. table salt in water  
c. air in water                      d. sand in water
- (x) The process which involves mixing:
- a. making tea                      b. making ice  
c. making steam                  d. all of these

**5.2 Match each statements of column A with the relevant statement of column B.**

A	B
Heating a solid	Formation of steam
Boiling water	Formation of ice
Cooling water	Formation of liquid

**5.3 Fill in the columns keeping in mind the state of matter.**

State of matter	Shape	Volume
Solid		
Liquid		
Gas		



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**5.4 Define the following:**

- |              |                 |                 |
|--------------|-----------------|-----------------|
| (i) Matter   | (ii) Mass       | (iii) Volume    |
| (iv) Mixture | (v) Decantation | (vi) Filtration |

**5.5 Describe the properties of the following:**

- |            |              |             |
|------------|--------------|-------------|
| (i) Solids | (ii) Liquids | (iii) Gases |
|------------|--------------|-------------|

**5.6 Describe the effect of heat on the following:**

- |            |              |             |
|------------|--------------|-------------|
| (i) Solids | (ii) Liquids | (iii) Gases |
|------------|--------------|-------------|

**5.7 Describe the process of filtration.**

**5.8 Make a list of six solids, four liquids and three gases from the things found in your kitchen.**

**5.9 Name a drink which can be prepared by mixing a solid, a liquid and a gas.**

**5.10 Why is it necessary to boil water before drinking?**