Chapter 1

MATTER AROUND US

B1L2J1

The word "matter" has very specific meaning in science. Let us try to understand the concept of matter.

You had read about metals, non-metals; synthetic and natural fibres, acids and bases etc., in previous classes. These are all examples of matter. All the things around us which exist in a variety of shapes, sizes and texture are also examples of 'matter'. The water we drink, our food, clothes and various things that we use in our day to day life, the air we breathe, even our body etc., are examples of matter.

Anything in this world that occupies space and has mass is considered as matter.

States of matter

In previous classes, you had learnt that water can exist as a solid (ice), a liquid or as a gas (water vapour).We say that solid liquid and gas are three different states of matter. Water can be found in all these states.

- Is there any substance which can be found in three states like water?

Now look carefully at different objects around you. You can classify them, into one of the three states of matter.

For example, you can say that wood and coal are solids and petrol is a liquid.

Milk is also a liquid like petrol. But the properties of petrol and milk are quite different from each other.

- What are the properties that lead us to consider petrol or milk as liquids?

Let us do some activities to understand the properties of solids, liquids and gases.

Properties of solids, liquids and gases

Shape and volume

- Do solids have definite shape and fixed volume?

Take two solid objects, say a pen and a book, and put them in different containers. Do you find any change in their shape or volume?

You might have seen a wide range of solids in your surroundings.

Imagine dropping a book or a pen on the floor. It does not flow but remains rigid with a definite shape, distinct boundaries and a fixed volume. This shows that solids have a definite shape and a fixed volume.

Activity-1

Identifying the shape and volume of liquids

For doing this activity, we need a measuring jar (cylinder) and containers of different shapes as shown in fig.--1.

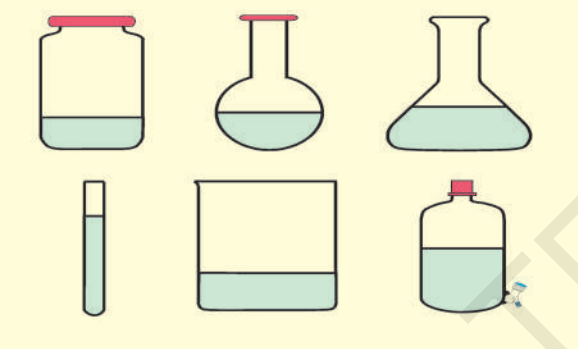

Fig -1: Different shaped containers having liquid of same volume

Note: It is not compulsory to collect same containers as shown in fig.- 1. You can collect the containers of different shapes available to you.

We also need some liquids like water oil and milk.

Take some water in one of the containers using the measuring jar. Examine the shape of water in the container. Pour the same water in another container and have a look at the shape, again. Repeat the process till you complete pouring of water in all containers.

- What is the shape of the water in different containers?
- Is the shape of water same or different in all the above cases?
- What shape does water take if it spills on the floor?

Take 50ml of water with the measuring jar and pour it in a tumbler. Mark the level of water on the tumbler and remove water from it.

Now measure 50 ml of the milk with the measuring jar and pour it in the same tumbler. Mark the level of the milk on it.

- Are the levels of water and milk same?

Remove the milk from the tumbler. Now pour oil into it up to the level marked for water.

- Can you guess the volume of oil?

This activity may seem very simple but we observe two important properties of liquids from this activity.

1) The shape of the liquid depends on the shape of the container.
2) Though liquid takes different shapes depending on the shape of the container its volume remains same.

Liquids can flow easily. Hence, they are also called **"fluids"**.

Look into in a dictionary of science to get its meaning.

You may find that gases have no fixed shape like liquids. Gases also flow like liquids. Hence both gases and liquids are called fluids. Then what are the differences between liquids and gases?

Activity-2

Do the gases have a definite shape and a fixed volume ?

You might have heard about CNG (Compressed Natural Gas). Go to a CNG pump and ask them where they store CNG. Also see where CNG is stored in a CNG run vehicle. Lastly see how CNG from the pump is transferred to vehicles.

- Does CNG have a fixed volume?
- Does CNG have a definite shape?

Fig - 2: CNG cylinder in a car

From the observations in the above activity and with our daily life experiences, we can find that CNG and all other gases neither have a fixed shape nor fixed volume.

Fig - 3: CNG gas filling station

Fig - 4: CNG tank at fuel filling station

Compressibility

Activity-3

Observing the compressibility of different materials

Take a 50ml syringe. Draw the piston to suck in air. Place your finger on the nozzle and press. Observe depth of piston moved into syringe. Is it easy or hard to press?

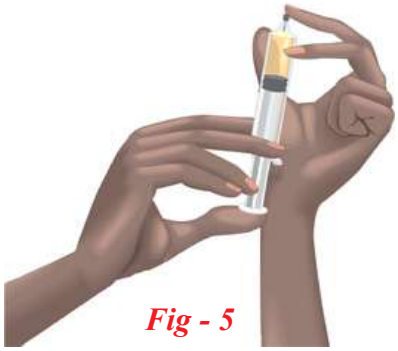

Fig - 5

- Do you find any change in the volume of air in the syringe?

Now fill water in the syringe and press the piston.

- When is it easier to press the syringe with water or air?

Now take a piece of wood and press it with your thumb.

- What do you observe when you press the wood?
- Is there any change in its volume?

From the above observations, you find that gases are highly compressible as compared to liquids and solids.

In our houses liquefied petroleum gas (LPG) is used for cooking. Now a days CNG is used in many auotmobiles. For all these purposes, large volume of gas is compressed into cylinders of small volume to make it portable.

Think and discuss

- Let us stretch a rubber band. Is there a change in its shape?
- Is rubber band solid or liquid? Why?

(What will happen if the stretching is stopped ? What will happen if the stretching is too much?)

Take some finely powdered salt (not crystals) and keep it in two different jars.

- Which shape does the powdered salt take?
- Can you say that salt is a liquid on the basis of change in its shape? Justify your answer.

Take a sponge. Observe its shape.

- Can you compress it? Is it a soild? Why? Think. Is anything coming out from the sponge when it is compressed.
- Why can't you able to compress a wooden block?

Diffusion

Activity-4

Observing the diffusion of gases

Ask your friend to hold an unlit incense stick and stand in one corner of the room. Then you go and stand in the other corner.

- Can you smell anything?

Now ask your friend to light the incense stick.

- Can you smell anything now?

When your friend lights the incense stick, the scent in the vapour form and smoke mixes with air and moves across the room and reach our nose.

In this case, smoke, vapour of scent and air are gases and are highly mobile.

If you spray a perfume or deodorant in one corner of the room, it spreads soon to all directions.

- Does the smell from burning incense stick and deodorant spray reach someone on the other end at the same time?

Activity-5

Observing the diffusion of liquids

Take 250 ml round bottomed flask with $\frac{2}{3}$ water in it. Use a dropper and put a few drops of blue or red ink or Potassium permanganate solution slowly along the side of flask.

Fig - 6: Diffusion of potassium permanganate in water

- What do you observe after adding the

drop of ink or Potassium permanganate?

- Can you observe that liquids also diffuse into each other like gases?
- How much time does it take the colour to spread evenly throughout water?
- What do you conclude from this activity?

Activity-6

Observing the diffusion of particles of solids into liquids

Take a beaker full of water and add a few crystals of potassium permanganate to it and observe the changes.

Repeat the experiment with crystals of copper sulphate.

- Do you observe diffusion?
- Is it faster or slower than that observed in the activities 4 and 5?

From activities 4, 5, and 6 it is clear that solids and liquids diffuse into liquids and gases diffuse in to gases. Diffusion is the movement of a liquid or gas from an area of higher concentration to an area of lower consentration. The particles will rise until they are evenly distributed.

Certain gases from atmosphere particularly oxygen and carbon dioxide, diffuse and dissolve in water and support the survival of aquatic animals and plants,

Diffusion therefore is a very important process for living things.

During respiration oxygen diffuses from lungs into blood. Carbon dioxide diffuses from blood into lungs.

Solids, liquids and gases diffuse into liquids and rate of diffusion of gases is higher than that of liquids or solids.

Diffusion of two gases

Lab Activity

Aim: To observe the speed of diffusion of two gases.

Material required: Long glass tube with scale, liquid Ammonia, Hydrochloric acid, pieces of cotton, two rubber corks and pair of tongs.

Fig - 7

Note: Teacher should take care of handling hydrochloric acid and prevent the children from touching the acid.

Procedure: Take a one meter long narrow glass tube.

Take two pieces of cotton. Soak one in hydrochloric acid solution and another in ammonia solution. Insert them separately at the two ends of the tube with the help of tongs. At the same time close the ends of the glass tube with rubber cork and observe.

The hydrochloric acid gives off hydrogen chloride gas and ammonia solution gives off ammonia gas.

Both gases react together to form a white fumes of ammonium chloride.

Observe the white ring in the tube due to formation of ammonium chloride.

Explain.

- How did the two gases travel along the tube?
- Which gas travelled faster?

Do this

So far you have studied some properties that can be used to distinguish between solids, liquids and gases. Fill the following table based on your knowledge.

Property	Solid	Liquid	Gas
Shape	fixed		
Volume		fixed	
Compressibilty			
Diffusion			

Can matter change its state?

We started our discussion by recalling that water exists in three states.

You must have seen many other materials that can exist in different states.

For example, coconut oil is usually liquid. But on cooling it becomes solid.

Camphor is a solid but if we leave it in the open air for some time it directly changes to gas.

You may have seen moth balls (naphthalene) being placed in clothes. The smell remains for some time even after the balls disappear. This is because the moth balls have changed from solid state to gaseous state.

But there are some substances that change directly from solid state to gaseous state and vice versa without passing through the liquid state. We have read about **sublimation** which is one such change.

Solids, liquids and gases are states of matter but you need to think about, why are the properties of same matter different in different states?

- When does water change into ice and then into vapour?
- Why do gases diffuse faster than solids or liquids?

Scientists have tried to explain these facts by examining the physical nature of matter.

What is matter made up of ?

All matter is made of very tiny particles. This looks as a simple statement but it is very difficult to explain and understand about matter.

For this we need more details about the particles and their arrangement inside various forms of matter.

Activity - 7

How small are the particles of matter?

Take a beaker with water and add 1 or 2 crystals of potassium permanganate and dissolve them in water.

- What colour do you observe ?

Now take out approximately 10ml of this solution and add it to 90ml of clear water in another beaker.

- What does happen to the colour of water in second beaker ?

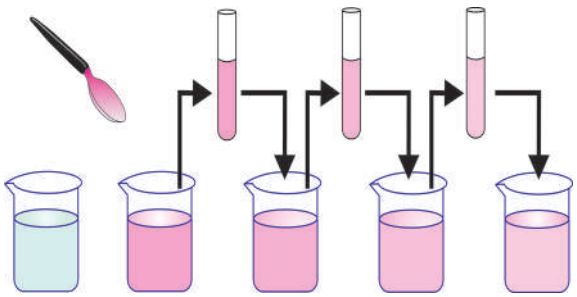

Fig - 8

Again take out 10ml of this solution and add to another 90ml of clear water. Carryout this process 4, 5 times as shown in fig.- 8 and observe changes in intensity of colour of the solution.

- Is the water in the last beaker still coloured?
- How is it possible for two small crystals of potassium permanganate to colour a large volume of water?
- What do you understand from this activity?

Repeat the activity by taking a few crystals of copper sulphate instead of potassium permanganate.

Several interesting conclusions can be drawn from the above activity.

We can conclude that there must be several tiny particles in just one crystal of potassium permanganate, which are uniformly distributed in water to change its colour.

Similarly a few crystals of copper sulphate too has several tiny particles which are distributed in large quantity of water to give colour.

So both solid and liquids (including water) are made up of tiny particles.

- How do the particles of the solid distribute in the liquid?

Let us find

Activity - 8

There exists space between particles

Take a graduated beaker and fill it with some water and mark the water level.

Add some salt and stir it thoroughly with a glass rod. Observe if there is any change in water level. Add some more salt and stir it again.

Observe the change in the level of water.

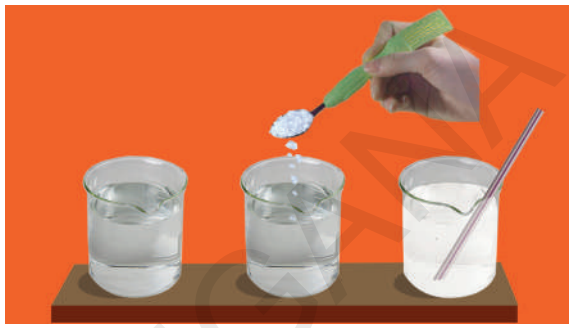

Fig - 9

- Does the level of water change?
- Where did the salt go?
- Can you see it in the water?

From the activities 7 & 8 we can conclude that liquid particles in a liquid have some space between them and the solid particles enter in to the space between the liquid particles on dissolving solid in liquid.

Recall the incense stick activity. Do you agree that gas is also made up of particles and they have large space between them.

Particles of matter attract each other

Activity - 9

Observing the force of attraction between the particles of matter

Open a water tap and allow the water to reach the ground. Now try to stop the stream of water with your finger.

- Are you able to move your finger through the stream of water any where from the tap to ground?
- What is the reason behind the stream of water remaining together?

  Now try to move your finger through an iron nail, as in the stream of water.
- Are you able to do it? If yes, does it rejoin?

From the above observations we can say that particles of the matter have forces acting between them that keeps the particles together.

It is also clear that this force is not equally strong and different in different forms of matter.

How diffusion takes place?

We have already carried out several activities to explain diffusion of particles of solids, liquids and gases. Diffusion can be possible only when the particles of matter move continuously.

In the incense stick activity, the particles responsible for scent move and enter the space between the air particles. The scent particles quickly spread across the room.

Particles of solids, liquids and gases can diffuse into liquids and gases. Rate of diffusion of gases is higher than the liquids, while the rate of diffusion of liquids is higher than solids. There are two reasons for higher rate of diffusion of gases.

1. Speed of gas particles is very high.
2. The space between gas particles is very high.

Similarly the greater diffusion rate in liquids compared to solids is because particles in liquids move freely and have greater space between them when compared to particles of solids.

Observe the following diagram which shows the difference in arrangement of particles in solids, liquids and gases.

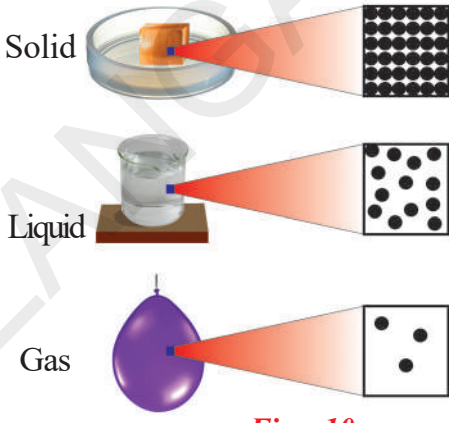

Fig - 10

In a gas the particles are not as close together as in a liquid. If a coloured gas is mixed with a colourless gas, the colour spreads evenly in it. This happens faster in gas than in a liquid, because of large gaps between the partcicles of gas. Fewer particles of gas obstruct in the way of spreading.

You can see the diffusion of bromine when it diffuses through air. Bromine is a brownish coloured gas. Hence its diffusion in colourless air can be seen clearly. If we allow Bromine to diffuse in vaccum, it diffuses faster into vaccum, because there are no particles to obstruct in its way.

Key words

Matter, states of matter, solid, liquid, gas, particles, diffusion, compressibility, forces of attraction, compressed natural gas.

What we have learnt

- Matter is made up of particles.
- The particles of matter are very small-they are small beyond our imagination.
- Particles of matter have space between them.
- Particles of matter move continuously in liquids and gases.
- Matter exists in three states i.e., solid, liquid and gas.
- The force of attraction between the particles are maximum in solids, intermediate in liquids and minimum in gases.
- The particles are arranged orderly in the case of solids while particles move randomly in gases.
- Diffusion is possible only when particles of matter move continously.
- Rate of diffusion of gases is higher than that of liquids (or) solids.

Let us Improve our learning

Reflections on Concepts

B3P4X7

1. Explian diffusion phenomena based on the states of matter. (AS_1)
2. Mention the properties of solids (AS_1)
3. Mention the properties of liquids (AS_1)
4. Explain "fluid" with one example. (AS_1)
5. Mention the properties of gases. (AS_1)
6. Give two daily life situation where you observe the diffusion. (AS_1)

Application of Concepts

1. Mention the applications of compressibility in our daily life? (AS_1)
2. Mention the situtions where we use diffusion in our day-to-day life (AS_1)
3. How can we smell perfume sitting several meters away from the source?(AS_1)
4. How do you prove that the speed of diffusion of ammonia is more than that of the speed of diffusion of hydrochloric acid? (AS_3)
5. Give examples that the matter which will be available in different states. (AS_1)

Higher Order Thinking questions

1. We can't rejoin the broken chalk easily. Give reason. (AS_1)
2. Is the space between the particles in the matter influence the speed of diffusion? Explain. (AS_2)

Multiple choice questions

1. Which of the following is available in three states in our daily life (at normal conditions)

   (a) Petrol (b) Water (c) Milk (d) Kerosine [ ]

2. Which of the following can be easily compressed to less volume. [ ]

   (a) Iron (b) Water (c) Air (d) Wooden piece

Suggested experiments

1. Conduct an experiment to observe the speed of diffusion of two substances.
2. Conduct an experiment to show the space between the particles of matter and write the report.

Suggested projects

1. Make a model to explain the structure of particles in solids, liquids and gases.
2. What are the factors influencing diffusion, whether the arrangement of atoms in the substance that diffuse or the arrangement of atoms of the medium in which the substance is kept.
3. Some solids diffuse in liquids but not in gasses, some solids diffuse in gasses but not in liquids. Why?