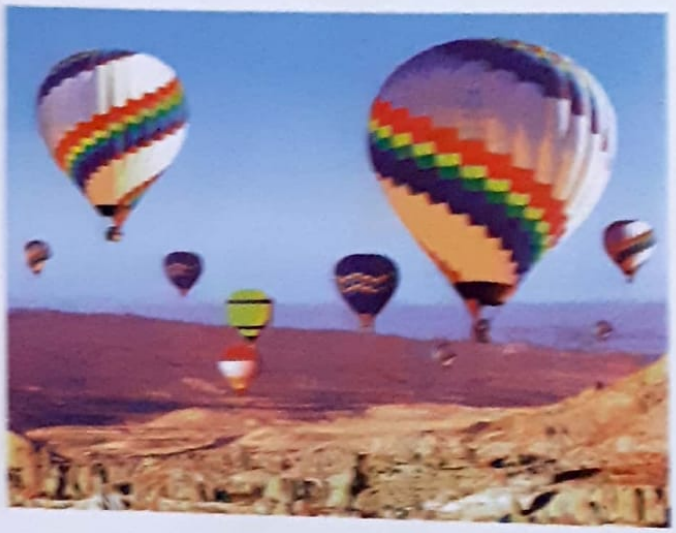
THEME 3

CHEMISTRY

MATTER

States of Matter

- Classification of matter into solid, liquid and gas on the basis of properties (shape, volume).
- Factors responsible for the existence of matter in different states.
- Arrangement of atoms/molecules in solids, liquids and gases: - (intermolecular space, cohesive forces).
- There is space between the particles of matter.
- Effect of heat on matter (expansion, change of state and chemical change).



THEME FOCUS

This theme focuses on enabling children to understand that matter around exists in different physical forms. i.e. solids, liquids and gases. One form can be converted into another. Matter expands on heating and on cooling, it contracts. Besides the physical changes, matter can also undergo chemical changes on heating.

Integration : Physics, Languages.

Life Skills : Cooperation and working together, creative thinking, decision making, conclusion drawing.

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3 MATTER

YOU WILL LEARN

What is matter?

Classification of matter

Intermolecular force and intermolecular space

- Solids, liquids and gases
- Sublimation

Change of States

What is matter made up of?

Elements

Classification of elements

- Metals
- Non-Metals
- Metalloids
- Noble Gases

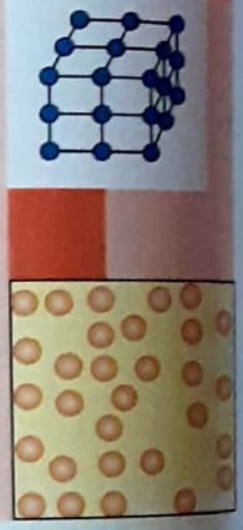
Compounds

Symbols

- Rules of writing symbols
- How are molecules of elements different from that of compounds?

Chemical Formula

- Valency



To live, each living being breathes in air. Life on this planet has been possible due to the presence of oxygen in air and water on earth.

To keep going we need energy, which is supplied to our body by the food, we eat.

To live, constantly, we are using substances in different physical states around us. Can we give them a name collectively? You may be surprised, but the answer is 'Yes'. They are all different forms of matter.

WHAT IS MATTER?

Matter is defined as anything that has mass and occupies space. Everything around is made up of matter. It is made up of atoms.

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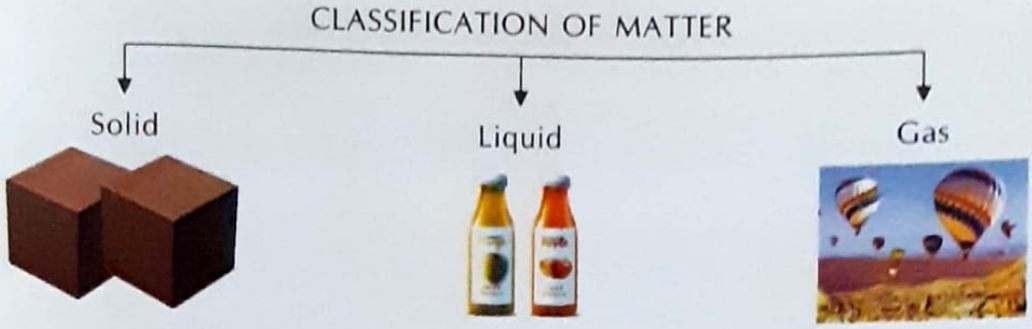


Fig– All pictures are showing three states of matter.

CLASSIFICATION OF MATTER

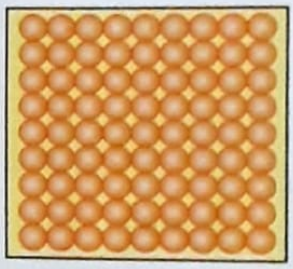
In nature, matter exists in three forms: solid, liquid and gas. All three forms of matter is made up of very small particles which can exist independently. These particles are called molecules.

INTERMOLECULAR FORCE AND INTERMOLECULAR SPACE

As a child you must have played with building blocks and made different shapes by changing their arrangement. In a similar manner, molecules are the building blocks of matter and different states of matter are due to difference in arrangement of molecules. Molecules attract each other. The force of attraction between molecules is called **intermolecular force of attraction**. In a similar manner, the space between any two molecules is called **intermolecular space**.

SOLIDS

Molecules are closely packed in a solid with little or no intermolecular space but very high intermolecular force of attraction. The molecules cannot move but vibrate at their places. Molecules possess less energy in a solid.



Fig– Intermolecular space in solids

Properties and reasons for exhibiting the properties.

1. Solids have a definite shape and occupy a definite space i.e. solids have a fixed volume.

   Reason– Since molecules are closely packed in a solid, they have least intermolecular space and strong intermolecular force of attraction. They cannot move from their place, giving solids a definite shape and volume.

2. Solids cannot flow.

   Reason– Due to the strong intermolecular forces, they cannot flow.

3. Solids are incompressible.

   Reason– As there is no place left in between the molecules, therefore, molecules cannot move closer to each other. As a result, solids are incompressible.

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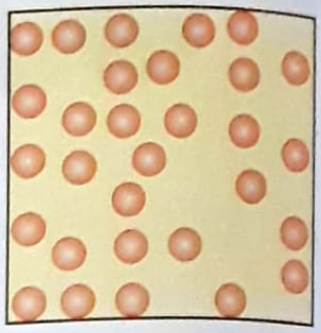
4. Solids have any number of free surfaces depending on their shape.

   Reason– Solids are those substances which have a definite shape and volume. They are non-compressible, cannot flow and therefore have any number of free surfaces.

LIQUIDS

In case of liquids, the molecules are not tightly packed and their position is not fixed. As compared to molecules in solid state, these molecules possess more energy. In comparison to solids, there is greater intermolecular space and lesser intermolecular force of attraction. The attraction between molecules is less, but still not so less that they may move in any direction. They can easily slide over each other and exchange or even change their places.



Fig– Intermolecular space in liquids

Properties and reasons for exhibiting the properties

1. Liquids don't have a definite shape but take the shape of container in which they are kept.

   Reason– As molecules of liquids are not tightly packed, they can easily shift and adjust by taking the shape of container in which they are kept. Not being compact, liquids don't have a fixed shape.

2. Liquids have a fixed volume.

   When we say half cup of milk, we have an idea as to how much space will be occupied by it. Similarly, if you are thirsty, you know how much water you can consume because we have a general idea of the volume of liquids.

   Reason– Since intermolecular force of attraction in a liquid is not very less as in case of solids hence, the molecules remain at an approximate distance from each other. Like solids, their places are not fixed but they just can roam away from their place.

3. Liquids flow from a higher level to a lower level under normal conditions. You can attribute this property to intermolecular force of attraction in liquids which don't allow molecules to stray.

4. Liquids can be compressed slightly because they have a definite volume.

5. Liquids unlike solids, have only one free surface.

   Reason– Since liquids have to be stored in a container, they take the shape of container. On three sides, they are bound by the walls of container but on the fourth side, they face the mouth of container and this is their free surface.

FACT

These is a fourth state of matter called plasma, but it is not often seen. It only exists at very high temperatures on inside the Sun and other stars, or on Earth at low pressures. It consists of atoms split up by great heat or electricity.

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Thus, any material which has a definite volume but no definite shape and has one free surface, is called **liquid**.

ACTIVITY

Take a small cup filled with water, a glass bowl and a coffee flask. Note the shape of water in the cup. It has one free flat surface as shown in the fig.

Now, invert the cup in a glass bowl. You will find that water flows into the bowl and takes the shape of the bowl, but its top surface is free and flat.

Pour the water from the bowl to the coffee flask, you will find that water flows into the flask and takes the shape of the flask with its top surface free and flat.

Now, again pour water from coffee flask to the cup. What do you observe? The cup again gets filled and the water takes the shape of the cup.

Fig– Liquids have one free surface.

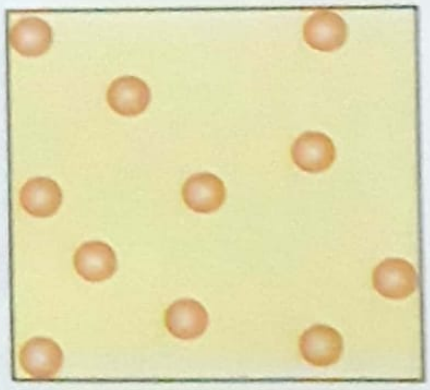
GASES

In this state of matter, molecules are far apart from each other. There is maximum intermolecular space and minimum intermolecular force of attraction. Molecules possess high energy and move freely in all directions.

Properties and reasons for exhibiting the properties.

1. Gases have no definite shape. They take the shape of containing vessel. Then, what is the difference between gases and liquids? Gases occupy every bit of space available. So, while you can say, give me a cup of tea but you cannot say give me a cup of air.

   Reason– As there is negligible or very less attraction between gaseous molecules, they move anywhere.



Fig– Intermolecular space in gases

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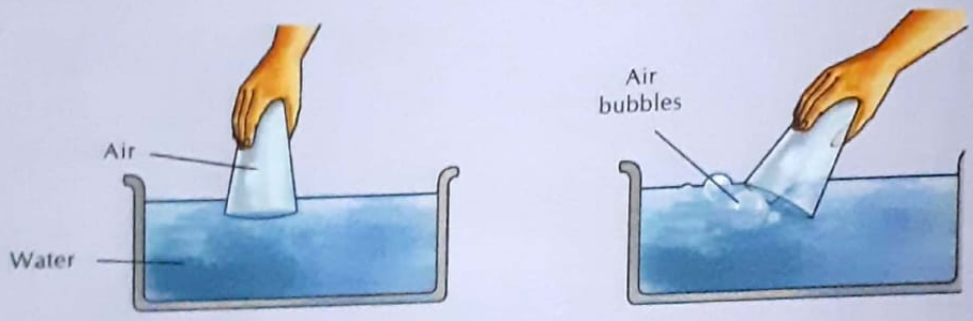
Take an empty glass tumbler and lower it vertically downward in a trough of water. Do you find it easy to push it down? What do you observe when you tilt the glass? In the first case, it is not easy to push down the glass. When you tilt the glass, bubbles of air escape out and water enters the glass. First of all, why was it difficult to push the glass? An empty glass is not empty, but is full of air. When you push an inverted glass in a trough of water, air resists the entry of water as it has occupied all available space in the glass. When you tilted the glass, air escaped as bubbles and water entered the glass.

This activity proves that air occupies space. i.e. it has volume but its volume is not fixed as it fills up the entire container.



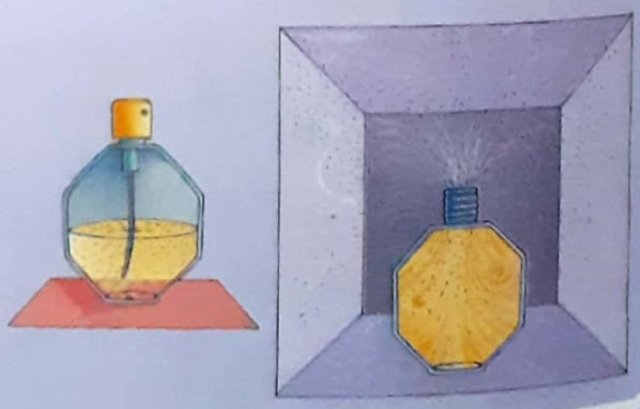
Fig– Air occupies space.

3. Gases have no definite volume.

Reason– Gases have large intermolecular spaces between them with the molecules free to move in any direction. Gases can flow in all directions because of negligible intermolecular force of attraction between their molecules.

ACTIVITY

Take an empty glass bottle and pour a few drops of perfume in it. Smell the bottle. You will be able to smell the perfume. Now, place this bottle in your drawing room and leave it undisturbed for a few minutes. You will observe that the whole room is filled with the smell of perfume. From this investigation, we conclude that gases have no definite volume. They have a property to fill the entire space available to them.



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