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# UNIT 7 MATTER AND MATERIAL AROUND US

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## 7.1 INTRODUCTION

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There are numerous things around us. They are made of different kinds of materials. All materials are made up of matter. There are innumerable matters. We cannot study the properties of all the matters. We classify them in different ways and then study the property of these classes. Materials may be classified on the basis of shape, size, colour or on the basis whether they are natural or man made. One of the most important basis of classification is their states, i.e., whether they are solids, liquids or gases.

All matters are composed of very very small particles called molecules. Many of the properties of solids, liquids and gases can be explained on the basis of this particulate nature of matter. When a solid substance; is dissolved in water or in any other liquid, it breaks up in very find particles which cannot be seen by our naked eyes. These are so small that they pass through the pores of a filter paper. What are the various conditions of dissolving a substance in a liquid quickly? These are some of the important concepts intimately related with the everyday life of the children. An effort has been made to bring home all these concepts to the children, through several planned/activities.

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## 7.2 OBJECTIVES

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After completing this unit you will be able to help your students :

- classify materials in the immediate environment according to certain observable characteristics like colour, hardness, size, roughness etc.;
- classify materials as solids, liquids and gases;
- perform experiments to show that the states of matter are interchangeable;
- state a few uses of solids, liquids and gaseous substance in our day to day life;
- devise and perform activities to show that water dissolves substances to form solutions;
- perform an experiment to show that hot water dissolves more solute than the same quantity of cold water;
- Perform activities to show that :
  - i) heating of water helps in dissolving a solid substance faster;

- ii) crushing of a solid substance into powder helps to dissolve a substance faster; iii) stirring of a solid substance in water helps in dissolving faster;
- identify other liquids which dissolve certain substance like kerosene, spirit;
- cite examples where a liquid could be used for separating two solid substances like sugar and sand or iron filings and wax;
- generalise that all matter is made up of small particles;
- see relationship between the particulate nature of matter and dissolving of materials in a solvent like water.

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### 7.3 VARIETY OF MATERIALS

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You see a variety of things around you such as table, chair, cat, utensils books, knife, trees, cows, insects, soil, fan, birds, chalk, pencil, clothes, etc. Are all these things alike? No, they are different in many ways. We cannot study the properties of all these materials individually hence we classify them. Then we study the general properties of each group. To bring home this concept to the students you may perform an activity in which all the students will participate.

#### Activity 1

Ask the children to collect different materials from their environment and group these materials according to their (a) colour (b) shape (c) size (d) man-made or natural (e) living and non-living.

**Grouping of things or what we call classification is a basic competency in teaching of science, which is very important.**

If due to lack of space it is not possible to carry on this activity individually, students may be grouped into threes.

After classifying the materials, students may be asked to write the names of various classifications in the tabular form.

**Writing in tabular form is also a competency which teaches them to work systematically.**

A simple table for recording the observations may be as follows:

S.No.	Natural object	Man-made object
1.		
2.		
3.		
4.		
5.		
6.		
7.		

There may be yet another way of grouping the things which depends upon their feeling of touch. Organise the following activity:

### Activity 2

#### Steps

- Collect a large number of things from your environment.
- Put stone-like hard things in one group.
- Put water-like things which need some container to keep them in another group.
- Put air-like things in the third group.

Ask the children to record their observations in the following table.

Stone-like things	Water-like things	Air-like things

It is possible that many air-like things may not be available. You may include a balloon filled with air in the collected things. At this stage, introduce them to proper terms like solids, liquids and gases. All stone-like things are called solids, water-like things are called liquids and air-like things gases. Tell them that all the materials can be classified into these three groups. All these groups have certain specific properties. Properties of these groups may be taught to the children by organising certain activities:

For the concept - "Do all these things have definite shape?" You may organise the following activity.

### Activity 3

#### Steps

- Take a solid object (a stone);
- Put it in a dish then in a tumbler, then on the table.

Ask the children "Does its shape change?"

- Take any other solid object.
- Put it in different vessels. Again ask "Does its shape change?"

Discuss it with the children and conclude that solids have definite shape.

- Now take water and fill it in different vessels. Ask the students "Does its shape change?"

From the responses of the children, conclude that:

The shape of water changes according to the vessel in which it is contained. Other liquids also acquire the shape of the vessel in which they are filled.

Also conclude that the solids have fixed shape while liquids do not have fixed shape. They take the shape of the container in which they are filled.

Ask the children:

What about air or other air-like things? Do they have a fixed shape? You may organise the following activity to clarify this concept.

#### Activity 4

##### Steps

- Take balloons of different shapes. (round, elongated and oval shaped.)
- Fill these balloons with air.
- What is the shape of air in these balloons? The shape of air is different in these three balloons.

Have a discussion with the children and conclude that:

Air has no fixed shape it takes the shape of the container in which it is filled. Similarly, all other air-like things, different gases do not have fixed shapes like solids and liquids.

Now pose a question to the students :

What about the volume of solids, liquids and gases? Does it remain fixed or varies?

They may give different answers. Discuss with them and then tell them that while solids and liquids have fixed volume, the volume of gases is not fixed. Solids and liquids contained in any vessel, will occupy equal space, it is not so with the gases.

Gases occupy all the available space and their volume is not fixed.

You may ask the students the following:

Can you tell one matter which is available in all the three states solid, liquid and gas? What is the solid form of water? What is the gaseous form of water?"

After discussion conclude that:

Ice is the solid form of water while steam is its gaseous form.

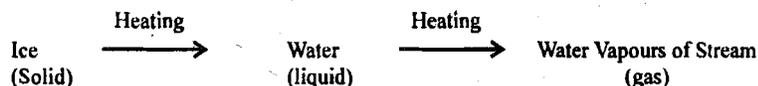
For further clarification ask the students to perform the following activity.

#### Activity 5

##### Steps

- Take some ice pieces in a dish.
- Heat it for sometime. What change do you notice? Ice melts into water.
- Continue to heat it till the water formed begins to boil.
- On further heating what do you observe? Water vapours are visible.

After the activity is over discuss and conclude:



Ask the students:

Are there some other substances which change their state on heating? Discuss it with the students. They may be knowing some examples from their experiences of day to day life. To bring home this concept following activity may be undertaken:

### Activity 6

#### Steps

- Take some wax or a piece of candle. It is in solid state.
- Heat it. What happens? It melts.
- Now allow it to cool. What happens? It again solidifies on cooling.

There are many other substances which melt during summer and solidify during winter.

Ask the students examples of such substances. They may be able to quote the examples of butter, coconut oil, etc.

At this stage you may introduce some technical words concerning this concept. The process of changing a solid into liquid by heating it called **melting**. The melting of a substance takes place at a fixed temperature called its **melting point**. Ice melts at 0°. Ice on melting forms water.

On boiling water, steam is formed which is the gaseous state of water. The temperature at which a liquid boil is called its **boiling point**. Boiling point of water is 100°.

Students must have observed in the kitchen that when water boils in a vessel, small water drops appear on its lid. These water droplets are formed when steam cools on the lid and gets converted into water. You tell them that this process of changing vapours into a liquid by cooling is called **condensation**. Ask the students "Have you ever thought how ice is formed from water?" Arouse curiosity and organise the following activity to bring home this concept:

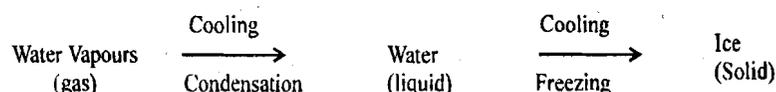
### Activity 7

#### Steps

- Take water in a test-tube
- Put it inside a beaker or any other vessel.
- Fill a mixture of ice and salt around the test-tube in the vessel.
- Wait for sometime. See what happens to the water in the test-tube. It solidifies into ice.

Once the student have seen the process of freezing of water, now the definition of freezing may be given: "The process of changing a liquid into solid on cooling is called **freezing**."

They may also be given the process of change of state in brief as follows:



### Check Your Progress

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

1. Fill in the blanks :

- i) Change of solid into liquid state by heating is called .....

ii) Change of liquids into vapour state by heating is called .....

iii) ..... is the temperature at which a liquid boils.

iv) Changing of vapours into liquid state by cooling is called .....

v) Change of liquids into solid state by cooling is called .....

2. Describe an activity to show that water freezes into ice on cooling.

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3. Device an activity to demonstrate the process of condensation of water vapours.

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4. Light a candle. Blow it off after a few minutes. What do you observe and smell? Bring a burning splinter quickly a little above the wick of the candle. What do you observe?

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## 7.4 SOLUTION AND SOLVENT

Now children are familiar with classifying the materials on the basis of shape, size, colour, natural or man-made, solids, liquids and gases. You tell them that there is yet another method of classifying the materials. Some materials are soluble in water and others are not. To classify the concept you may organise the following activity.

**Activity 8**

**Steps**

- Take water and a small container.
- Take some substances like sugar, salt, chalk powder, turmeric powder, small alpins, washing soda, sand, etc.
- Take some water in the container and add a pinch of sugar. Shake them well. See what happens, whether sugar dissolves in water or not,
- Similarly take each substance one by one and try to dissolve it in water.

Children may record their findings in the following table.

S.No.	Soluble in water	Insoluble in water
1.		
2.		
3.		
4.		
5.		

By performing this activity children have seen that water dissolves many substances. Ask them-Do other liquids also dissolve so many substances? Probably they will not be able to reply. Arouse their curiosity and organise the following activity.

### Activity 9

#### Steps

- Take liquids like kerosene and spirit.
- Take a small amount of these liquids in different test-tubes.
- Add a pinch of sugar in each and shake well. What happens?
- Add a little salt in other test-tube having kerosene and spirit and shake well to dissolve them. What happens?
- Try to dissolve other substances taken in the previous activity one by one.

Children may be asked to record their observations in the following table:

S. No.	Substances	Soluble in Water	Soluble in Kerosene	Soluble in Spirit
1.	Sugar			
2.	Salt			
3.	Chalk powder			
4.	Turmeric powder			
5.	washing soda			
6.	Sand			

Conclude from this activity that water dissolves more substances in it which kerosene and spirit do not dissolve. Hence we can say that water is a great solvent. Tell them that the water which we are using in our daily life is never pure. It always has something dissolved in it. These dissolved substances impart their peculiar taste to water. This is the reason why water at different places tastes differently.

Put up a question to them.

Can we dissolve any amount of substance in a given quantity of water? Probably children will not be able to reply this question. Arouse their curiosity and arrange the following activity in groups:

### Activity 10

#### Steps

- Take some water in a dish.
- Add some sugar in it and dissolve it by stirring.
- Add some more sugar and try to dissolve it.
- Go on adding more and more sugar in small quantities and try to dissolve each time.
- Ultimately a stage comes when no more sugar dissolves in it. It settles at the bottom.
- Add some more water in the dish.
- Now try to dissolve the sugar settled at the bottom. What happens? It does not dissolve.

Conclude from this activity that a fixed quantity of water can dissolve only a limited quantity of a substance.

Now again pose a problem before them:

Does dissolving a substance also depend upon the temperature of the liquid?

Arouse their curiosity and organise an activity to satisfy it.

### Activity 11

#### Steps

- Take equal amount of water in two dishes, one containing hot water and another having cold water.
- Add equal amount of sugar in each and dissolve.
- Go on adding equal amount of sugar in both, till it stops dissolving. What do you observe?
- Discuss with the children the results of their findings.

Conclude from your discussion that a given quantity of water can dissolve only a fixed quantity of a substance at a particular temperature. Hot water can dissolve more substance than cold water.

Again pose a problem before them:

Is the quantity of different substances dissolved in same amount of water same or does it differ?

Arouse their curiosity and perform the following activity :

### Activity 12

#### Steps

- Take equal amount of water in two dishes.
- Take equal amount of sugar and salt on two separate papers.

- Dissolve sugar in one dish and salt in the other dish from the sample you have taken.
- Go on dissolving both salt and sugar in separate dishes till no more substances can be dissolved.
- Estimate the quantity of sugar and salt dissolved.
- Are the quantities of both the substances dissolved equal?

Discuss with the children and conclude that quantity of different substances which can be dissolved in a given quantity of water at constant temperature is different.

Now pose a problem before the children - what are the conditions which facilitate rapid dissolving of a substance in water. Organise group activities of the children to make them find out themselves the various conditions for it. Do not tell them the results before hand.

### Activity 13

#### Steps

- Take equal amount of water in two dishes.
- Take two samples of equal amount of salt (as much as can be dissolved).
- Heat water in one of the two dishes.
- Put one sample of salt in one dish and another sample in another dish.
- Try to dissolve them.
- Which one dissolves earlier?

After the activity is over, discuss with the children and conclude that heating of water helps in dissolving a solid substance in water faster.

Organise another activity for the other condition.

### Activity 14

#### Steps

- Take equal amount of water in two dishes.
- Try to dissolve sugar crystals in one dish and fine powdered sugar in the other.
- Which one dissolves earlier?

Discuss with children, involving each group and conclude that crushing of a substance into powder helps to dissolve the substance in water faster.

Similarly for another condition, dissolving substances organise another activity.

### Activity 15

#### Steps

- Take two dishes having equal amount of water.
- Add equal amount of a substance to be dissolved in both the dishes.
- Stir the substance by a rod in one of the two dishes and do not stir in the other.
- What effect of stirring do you observe?

### Activity 16

#### Steps

- Take water in three test-tubes.
- Put a piece of wax in one test-tube and try to dissolve it by shaking the test-tube well.
- Put some greese or any oil in the second test-tube and try to dissolve it.
- Put a small piece of coal tar in the third test-tube and try to dissolve it.

Children will find out that all the three substances do not dissolve in water. Now give them some kerosene and ask them to dissolve these three substances.

They will find that kerosene does not dissolve greese, wax and coal tar.

Tell the children that property of liquids to dissolve solid substances help us to separate one substance from another if one of the two is solvable in it.

Ask them how can you separate sand from a mixture of sand and sugar.

Discuss and organise an activity to do it.

### Activity 17

#### Steps

- Add sufficient water in the mixture of sand and sugar.
- Continue to stir it till whole of sugar dissolves in the water.
- Filter it.
- Sand remains on the filter paper.

Thus children will find out themselves how sand can be separated from a mixture of sugar and sand.

Based on this knowledge you may discuss how iron filings can be separated from iron filings embeded on wax. After the discussion you may also organise activity on it.

### Activity 18

#### Steps

- Put wax pieces embedded with iron filings in a vessel.
- Pour some kerosene in it and dissolve wax in it by stirring well.
- Filter the contents of the vessel.
- Iron filings stay on the filter paper.

Now children have seen how a liquid can be used to separate two solid substances from their mixture. Ask them to find other examples in their day to day life. Discuss how kerosene can be used to remove the stains of coal tar or any grease from a cloth. If needed, demonstrate it in the class.

#### Check Your Progress

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

5. You have to serve lemon-water to your guests. You have lemons, ice cubes, sugar crystals and water with you. How you -can make the lemon-water as quickly as possible. Write in steps.

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6. You have a mixture of salt and iron-filings with you. How can you separate iron filings from it?

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7. Unluckily you got a stain of coal tar on your shirt. How will you remove it?

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8. You have to weigh a solid piece of salt inside a liquid. What liquid will you take for it so that the salt does not dissolve in it?

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## 7.5 PARTICULATE NATURE OF MATTER

Introduce the concept by posing a problem before the children. Ask them that if you dissolve a solid substance in a liquid it is not visible in the solution. Even if you filter the solution by a filter paper, nothing remains over the filter paper and all the solution passes through it. Have you ever thought that where does that substance go?

Discuss it with children and to make it clear, organise the following activity:

### Activity 19

#### Steps

- Take a chalk piece.
- Grind it with the help of grinding stone or hammer.
- Now observe fine particles of chalk.
- Every little particle has the same properties as that of bigger piece.

Put a question to the students. Upto what extent can we divide a substance into fine particles?

Tell them that a substance can be divided into such small particles which cannot be seen by our naked eyes. They are so small that even they cannot be seen by a powerful microscope. At this point give them the definition of a molecule. **The smallest particle of a substance which retains all its properties is called its molecule.**

Tell the students the concept that matter is composed of very fine particles to us. Perform the following activity before the children and let them observe it carefully.

### Activity 20

#### Steps

- Take some water in a beaker or a glass tumbler.
- Drop a few potassium permanganate crystals in it. Do not shake or stir it.

Ask the children to observe it carefully and then describe what they have observed.

1. They may describe that potassium permanganate crystals move up and down thereby spreading the colour uniformly in the whole water.
2. Crystals of potassium permanganate are not visible after sometime.

Discuss with the children and conclude that: Potassium permanganate crystals break up into very fine particles which spread through out the liquid. This is the reason why whole of the water becomes coloured.

Similarly when we dissolve sugar in water, sugar crystals break up into fine particles which spread through out the water. Thus whole water acquires the sweetness of sugar.

Now pose a problem to the children :

How can you get back the dissolved substances from the solution? Probably they won't be able to reply correctly Organise an activity to show it.

### Activity 21

#### Steps

- Take some water in a dish.
- Dissolve some salt in it. Stir it till whole of the salt dissolves.
- Filter the solution: Why?
- Take the filtrate in another dish and heat it. What happens?
- Water evaporates and the dissolved salt is left behind in the dish.

Ask the children:

Is there any other way of getting back the dissolved salt?

If they are not able to reply, put a suggestive question to them.

If instead of heating the solution we keep it in sun, then what happens?

Discuss and conclude that : In that case also water evaporates but slowly. It takes a longer time to get back dissolved substance. In both the cases, crystals of common salt are left behind. We get bigger crystals when the water is evaporated slowly.

Ask the children:

Do you know how common salt is obtained from the sea water. Probably they will not reply correctly. Tell them that sea water is kept in shallow trenches. Water evaporates slowly. When all the water is evaporated, large crystals of common salt are left behind.

Ask the children:

Can we dissolve only solid substances in liquids? Can we dissolve a liquid in another liquid? What happens when water is added to milk? Discuss with them and draw the conclusion that liquids can be dissolved in other liquids.

Again ask the children:

Do gases also dissolve in water? Discuss with them and organise the following activity.

### Activity 22

#### Steps

- Take some tap water in a beaker.
- Heat it and observe.
- Bubbles of air are visible on the walls of the beaker inside the water. Where have these bubbles come from?

Probably they will not be able to reply it correctly. Tell them it is the air soluble in water which comes out on heating in the form of bubbles. This property has wide application in nature. All fishes and other animals living inside the water take this air for their respiration.

Again ask the children:

Is there any other application of dissolving a gas in water in our day to day life? What is there in a soda water bottle? Discuss with the children and conclude that gas dissolved is carbon dioxide.

Ask the children:

In what other ways do materials differ from each other? Organise the following activity in groups and do not disclose its outcome. Let them explore themselves this particular property.

### Activity 23

#### Steps

- Collect materials like celluphane paper (plain or coloured), ordinary white paper, glass-sheet, card-board, tin sheet, plastic-sheet, etc.
- Hold each item one by one and try to see through them. Are you able to see through them?
- You may be able to see through celluphane paper, glass-sheet and probably through a thin plastic sheet. But you won't be able to see through a white sheet of paper, a card-board, or a tin-sheet.
- Now hold a torch against the materials through which you can see. Does the light of the torch passes through those materials?

After the activity is over, tell them the correct words for those classes of materials. Materials through which you can see or through which light can pass are called **Transparent**. Those materials which do not allow the light to pass through them are called **opaque**.

Ask the children to perform the following activity. Do not tell them the outcome in advance. Let them explore.

### Activity 24

#### Steps

- Take a piece of chalk, some iron-nails, piece of wood, stone-piece, chalk-piece, wool.
- Strike each of them by a hammer. What do you observe?
- Some of these materials break easily while others do not.

They may record their findings in a table as shown below:

Breakable	Unbreakable

**Check Your Progress**

Notes: a) Write your answers in the space given below,

b) Compare your answers with those given at the end of the unit.

9. Describe an experiment to show that hot water dissolves more substance than some amount of cold water.

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10. Describe an activity to show that crushing of a solid material helps in dissolving it faster.

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11. Why is a substance is not visible after it is dissolved in a liquid.

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12. How will you get back a salt from a mixture of sand.

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## 7.6 LET US SUM UP

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- Materials can be classified on the basis of colour, size, shape, hardness, smoothness, etc.
- Materials can also be classified as solids, liquids and gases:
- Solids have fixed volume and fixed shape.
- Liquids also have fixed volume but do not have fixed shape.
- Gases neither have fixed volume nor fixed shape.
- Materials change their states on heating or cooling.
- Water is a great solvent. It dissolves many substances.
- Kerosene dissolves, paint, greese, wax and coal tar.
- Stirring makes a solute dissolve faster.
- Crushing of a solid substance into powder helps to dissolve the substance faster.
- More solute can be dissolved at higher temperatures.
- Higher temperature of the liquid helps dissolve a substance faster.
- Property of dissolving helps in separating one substance from another (sand from sugar or wax from iron filings).
- Every matter is made up of very small particles.
- Smallest particles of a substance is known as molecules.
- When a substance is dissolved it breaks up into very fine particles.
- When a solution is filtered nothing remains on the filter paper.
- Liquids can also be dissolved in other liquids, e.g., milk or spirit in water.
- Gases can be dissolved in liquids (e.g. air in water or carbon dioxide in soda water.)
- Materials through which light can pass are called transparent, e.g., glass sheet, celluphane paper.
- Materials through which light cannot pass are known as Opaque, e.g., tin-sheet, card-board.
- Some materials can transmit heat while others cannot. Iron and other metals are good transmitters while wood, plastic cannot.
- Some materials can be broken into small pieces on hammering, e.g., chalk, coal.
- Others cannot be broken into small pieces on hammering like iron-nail, metal-sheets.

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## ANSWERS TO CHECK YOUR PROGRESS

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1. i) melting, ii) evaporation, iii) boiling point, iv) condensation, v) freezing.
4. Carbon-dioxide is relased during burning which extinguishes the burning splinter.

5. Stir water and sugar crystals, add lemon and then ice-cubs.
6. By dissolving salt and iron-filings, with water and filtering the contents.
7. With kerosene.
10. Sugar crystals in water.
11. Because of particulate nature of matter. You can further elaborate.
12. After evaporation.