8 Material and Solutions

We'll cover the following key points:

- Matter and Change of State
- Solute, Solvent and Solution
- Methods of Separation

Hi, I'm EeeBee

Do you Remember:

Fundamental concept in previous class.

In class 3rd we learnt

- States of matter

Still curious? Talk to me by scanning the QR code.

Learning Outcomes

By the end of this chapter, students will be able to:

- Understand the concept of matter and its various states, including the changes that occur between these states.
- Explain the process of change of state, including melting, freezing, condensation, and evaporation.
- Describe the components of a solution, including solute and solvent, and how they interact.
- Identify different methods of separation and their applications, such as filtration, distillation, and chromatography.

Guidelines for Teachers

The teacher can begin the chapter by explaining the concept of matter and its different states, emphasizing the transitions between solid, liquid, and gas. Use diagrams or models to illustrate the changes in state and explain the processes like evaporation, condensation, and freezing. Provide real-life examples such as the melting of ice or water turning to steam to demonstrate changes of state. When introducing solutions, focus on the definitions of solute, solvent, and solution, and use simple demonstrations such as dissolving sugar in water. Highlight various methods of separation, demonstrating through experiments like filtering sand from water or distilling saltwater to obtain fresh water. These activities can make the topic more engaging and practical for students.

Warm Up

Experiential Learning

Given below are some substances. Write (D) against ones which dissolve in water and (ND) against ones which does not dissolve in water:

1.	Salt	_____	2.	Rice powder	_____
3.	Saw dust	_____	4.	Besan	_____
5.	Husk	_____	6.	Glycerine	_____
7.	Mustard oil	_____	8.	Pepper	_____
9.	Sand	_____	10.	Oxygen	_____

Fun Fact

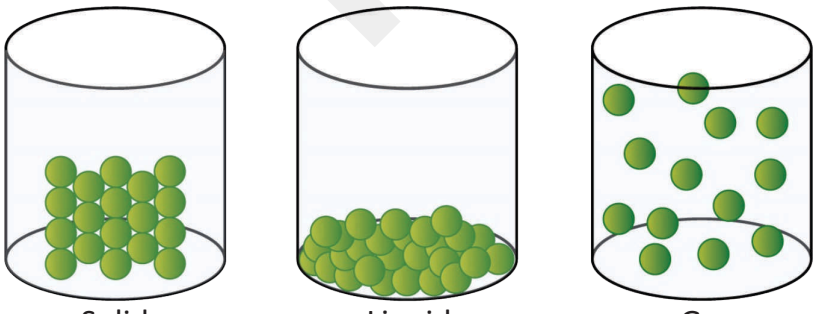
Salt was so valuable in ancient times that it was used as currency! Roman soldiers were often paid in salt, leading to the phrase "worth his salt." Salt has been crucial in preserving food and maintaining health for centuries. Even today, it's an essential mineral in our diet.

Take a Task

Watch Remedial

Matter and Change of State

Matter is all around us! Matter is defined as anything that has mass and takes up space. Solid, liquid and gas, everything you see, touch, and even breathe is made of matter. Matter is made of atoms, and the arrangement of the atoms determines whether the substance is solid, liquid or gas. The particles of ice, water and steam are identical, but arranged differently.



Solid Liquid Gas

Molecular arrangement of solids, liquids and gases

Do you know ?

Water is the only substance on Earth that naturally exists in all three states of matter–solid, liquid and gas.

Change of State

Matter can change from one state to another, if heated or cooled. If ice (a solid) is heated it changes to water (a liquid). This change is called melting.

The change from liquid to solid is called freezing or solidifying. It is the opposite process to melting.

If water is heated, it changes to steam (a gas). This change is called boiling. Water boils when it reaches its boiling point of 100ºC. This is the temperature at which water turns to steam. Steam is an invisible gas. When it reaches the lid it cools back to a liquid.

Even without boiling water in a kettle, some of the water changes to gas. This is evaporation. The process of evaporation is a continuous one.

Water that is present as a gas in the air cools down and changes into tiny drops of liquid water. This change from gas to liquid is called condensation.

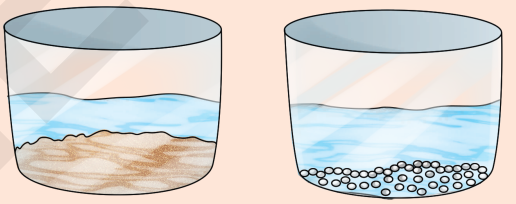
- What are solids, liquids and gases?
- How can water be a solid, a liquid and a gas?
- Why does my ice-cream melt in the Sun?
- Why does water start bubbling in the kettle when it gets hot?
- What change of state takes place when a substance melts?

Solute, Solvent and Solution

Activity

Creative Learning

Take two cups of water and a tablespoon of sugar and a tablespoon of sand. Place the tablespoon of sugar in one cup of water, and the tablespoon of sand in the other cup. Observe what happens. You would see the sand sink to the bottom of the cup while the sugar dissolves and mixes into the water evenly.



Solutions are made up of solvents and solutes.

The **solvent** makes up the largest amount of a solution. It is the substance into which another substance dissolves. Water here is the solvent.

The **solute** makes up a smaller amount of a solution. It is the substance that dissolves into another substance. Sugar here is the solute.

The more solute there is in a solution, the higher the **concentration** is.

Example: The more sugar (solute) if added to water (solvent), the higher the concentration of the solution will be.

Water is known as the universal solvent as it can dissolve many substances.

Solutions are mixtures that look like one substance. It is the mixture formed when a solute dissolves in a solvent.

Did you know ?

If you pour a handful of salt into a full glass of water, the water level will actually go down rather than overflowing the glass. The salt molecules take up all the spaces between water molecules.

Examples:

- The air we breathe is a solution of a number of gases.
- The fluids in our bodies are solutions that carry all kinds of essential nutrients and other materials.
- Fizzy drinks are a solution of a gas (carbon dioxide) in water. The bubbles that come out when you open the bottle are actually carbon dioxide.

Activity

Creative Learning

Take 6 cups of water and try to mix sugar, salt, sand, oil, vinegar and chalk powder separately in each cup. Then complete the table using your observation:

Mixture	Is the mixture a solution after stirring? (Yes or No)
Sugar and water	
Salt and water	
Sand and water	
Oil and water	
Vinegar and water	
Chalk powder and water	

In the above activity, we mixed different substances with water. Answer the following questions:

- Which substance is the solvent in all the mixtures?
- Choose an example of a solution that consists of a solid solute and a liquid solvent.
- Choose an example of a solution that consists of a liquid solute and a liquid solvent.
- Choose an example of a mixture of two liquids that is NOT a solution.

The substances that form solutions when they are mixed with water are called soluble substances. Some substances that are soluble in water are salt, soap, orange juice, coffee ,milk etc.

The substances that do not form solutions when they are mixed with water are called insoluble substances. Some substances that are insoluble in water are sand, oil, chalk powder, mud, wax, sawdust etc.

A miscible mixture is a mixture of two liquids that completely combines together to form one solution. For example: milk and water, lemon juice and water etc.

An immiscible mixture is a mixture of two liquids that doesn't mix completely. These mixtures, like oil and water, will never mix together fully. The lighter liquid floats on the top of the heavier liquid. Oil being lighter floats on the surface of water.

Did you know ?

Carbonated beverages like Coca-cola, Sprite etc. are made by dissolving carbon dioxide gas into liquid at high pressure.

Activity

Creative Learning

How much solute will dissolve?

Materials:

- Clear container (a glass beaker would be best, although a large yoghurt tub would also work, but not if you decide to heat it later)
- Tap water
- Small packet of sugar
- Plastic spoon for scooping and stirring

Instructions:

1. Measure half a cup of water into the container.
2. Add a teaspoon of sugar to the water. Stir until all the sugar has dissolved.
3. Add another teaspoon of sugar and stir again.
4. Keep adding teaspoons of sugar until no more sugar can dissolve.

Questions:

How many spoons did you add until no more sugar dissolved? _____

How did you know that no more sugar could dissolve? _____

Saturated Solution

In this experiment, the solution reaches the point at which it cannot dissolve more solute(sugar) and the sugar you add sinks to the bottom in solid form. This is now a saturated solution.

When no more solute can dissolve in a solution, we say it is a saturated solution.

An unsaturated solution is one where it is possible to dissolve more solute in the solvent.

Check 'N' Mate — Critical Thinking

Write 'T' for true and 'F' for false statements.

1. The process of evaporation is a continuous process in nature. ☐
2. The more solute there is in a solution, the lesser the concentration is. ☐
3. Insoluble substances do not form solutions. ☐
4. The lighter liquid floats on the top of the heavier liquid. ☐

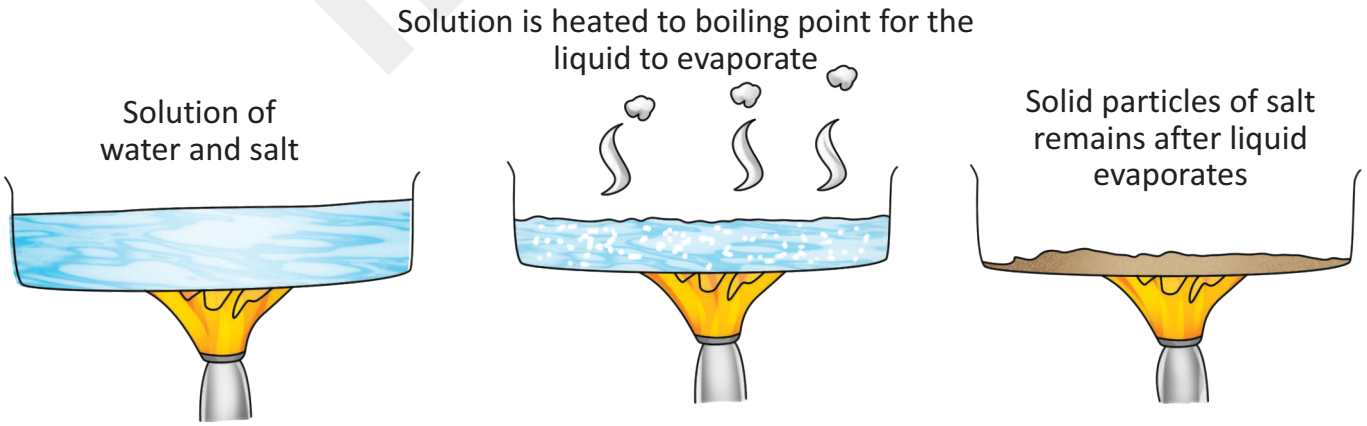
Take a Task | Watch Remedial

Methods of Separation

Separation of soluble substances

Evaporation is the best way for separating a mixture (solution) of a soluble solid and a solvent. The process involves heating the solution until the solvent evaporates (turns into gas) leaving behind the solid residue. Salt is obtained from sea water by this process. Sea water evaporates due to the heat of the Sun and salt is left behind.

Here is a simple example involving a mixture of salt and water.

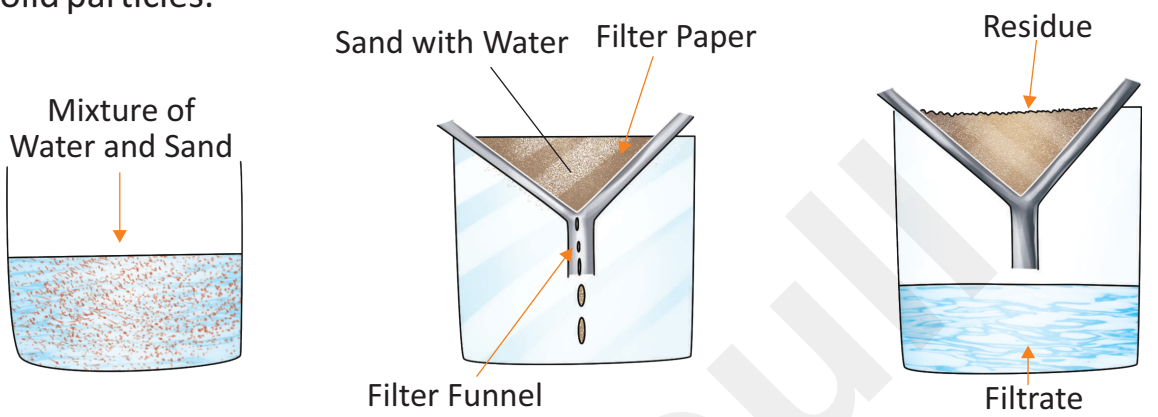


Separation of insoluble substances

Insoluble substances can be separated from a liquid by the processes of filtration, sedimentation and decantation.

Filtration

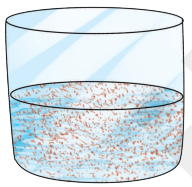
This process involves the use of a filter paper placed in a filter funnel. The funnel is placed in a beaker and the mixture of water and sand is poured into the funnel. The liquid part drains through the filter paper into the beaker, leaving the solid sand particles trapped on the filter paper. In filtration, the liquid part collected is called the filtrate and the solid bit that remained on the filter paper is called the residue. An example of such a mixture is sand and water. Filtration is used in water treatment plants, where water from the river is filtered to remove solid particles.



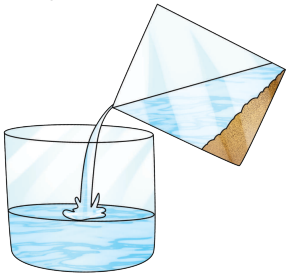
Sedimentation and Decantation

If the mixture of insoluble impuri ties, *e.g.* sand and water is allowed to stand undisturbed in a beaker. After some time, the sand settles down at the bottom of the container as sediments. This process is called sedimentation.

Clean water obtained from the process of sedimentation can then be poured out into a separate container without disturbing the sediments. This process is called decantation.



Sedimentation



Decantation

Check 'N' Mate

Critical Thinking

Fill in the blanks with correct words.

1. _____ (Evaporation/Condensation) is the best way for separating a mixture of a soluble solid and a solvent.
2. Sea water evaporates due to the _____ (heat/light) of the Sun.
3. _____ (Filtration/Evaporation) is used in water treatment plants.
4. The solid bit that remained on filter paper is called _____ (residue/remainder)

In a Nutshell

- A solution is a special kind of mixture. Like all mixtures it consists of two (or more) substances mixed together.
- A solution is made up of a solvent (such as water) in which one or more solutes have been dissolved.
- In a solution, the solute looks as if it disappears into the solvent. This is because the particles of the solute and the solvent become closely mixed.
- There are many kinds of solutions, but the most well-known ones are mixtures of a solid and a liquid, such as sugar and water.
- Not all substances dissolve in water. Those that dissolve are called soluble substances; those that do not dissolve are called insoluble substances.
- A Soluble solid can be separated by heating so that the solvent evaporates. The dry solute will be left behind.
- An insoluble solid can be separated from a liquid by filtration, sedimentation and decantation.

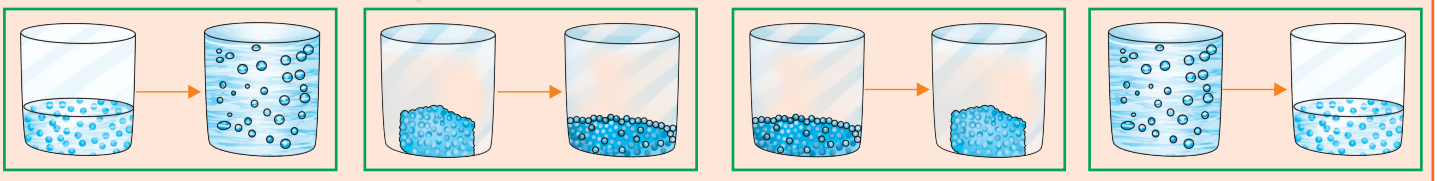
Key Words

Improving Vocabulary

Identical	:	Exactly alike
Concentration	:	The amount of a substance (solute) present in a given volume of solvent or solution.
Residue	:	Left over

Time to Observe

Observing, Critical Thinking, Analysing



1. Label which picture shows melting, freezing, evaporation and condensation.
2. Below each picture write adding heat energy or taking heat energy.
3. When you add heat energy the molecules move _____ and _____ .

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EXERCISE

That turn curiosity into confidence—let's begin!

A. Objective Type Questions.

1. In a solution, the substance that dissolves is the :

   a. Solid b. Solute c. Solvent

2. What is the definition of a solute?

   a. A mixture of two solutions

   b. That gets dissolves into a solvent

   c. Water

3. _____ is a universal solvent.

   a. Oil b. Water c. Acid

4. Which statement describes a solution of salt water?

   a. Salt is the solvent, water is the solute

   b. Salt is the solute, water is the solvent

   c. Salt is the solution, water is the solute

5. How could I make a powdered drink mix having a stronger flavour or make it more concentrated?

   a. Add more solvent b. Heat it c. Add more solute

6. When a solution can still dissolve more solute due to it having less solute than its maximum amount, what is the solution called?

   a. Unsaturated b. Saturated c. Supersaturated

B. Name the following :

1. Any substance that has mass and occupy space _____
2. The boiling point of water is _____
3. A gas dissolved in soft drinks to make them fizzy _____
4. Liquids that do not mix together _____
5. Liquid that mix together _____
6. The process of changing a liquid into a solid on cooling _____
7. The process of changing a liquid into gas on heating _____
8. The process of changing a solid into liquid on heating _____
9. The process of changing a gas into liquid on cooling _____

C. Match the following:

Column A	Column B
1. Filtration	a) This process involves heating the solution
2. Sedimentation	b) This process involves use of filter paper
3. Evaporation	c) In this process, insoluble impurities are allowed to stand undisturbed

C. Very Short Answer Questions.

Name the following :

1. The process by which a solid changes to a liquid: _____
2. The process by which a liquid turns into a solid: _____
3. A solid that dissolves in a solvent : _____

D. Short Answer Questions.

1. What is matter?
2. What are the different states of matter?
3. What is melting and what is freezing?
4. What is saturated and unsaturated solution?

Custom Learning Path

Scan to Create Your Own Learning Path

E. Long Answer Questions.

1. Explain by taking the example of water, how matter change its form from one state to another.
2. What are soluble and insoluble substances? Give examples.
3. Differentiate between miscible and immiscible substances.
4. Explain the term solute, solvent and solution with the help of examples.
5. How can you get back salt from a solution of salt and water?
6. How can you separate sand particles from water? Explain with the help of a diagram.
7. Explain the processes of sedimentation and decantation with the help of diagram.

Time to Create

Creating and Collaborating

You can make your own orange lolly sticks. A great healthy treat for summer.

1. Make orange juice from two oranges.
2. Pour it into ice trays with lolly sticks and freeze it.
3. After three to four hours, you can enjoy your lolly sticks.

Time to Recall

Remembering and Analysing

Complete the table below to summarise the properties of solids, liquids and gases. Use a tick to indicate which properties each state usually has.

Property	Solid	Liquid	Gas
1. Has a definite shape that is difficult to change			
2. Takes up a fixed amount of space			
3. Can be poured			
4. Takes up all of the space available			
5. Can be compressed			
6. Is made of particles that are strongly attracted to each other and can't move past each other			
7. Is made of particles that are not held together by attraction			

Time to Apply

Applying and Creating

1. Victor has two glasses. One glass is filled with ice cubes and the other is filled with water. Give three ways the ice and water are different.

ICE	WATER

2. A balloon is attached to the mouth of a bottle containing club soda. The bottle is then shaken gently and laft to stand for some time. The balloon gets inflated. Why?

Time to Discuss

Pondering and Communicating

1. What is the method used by your mother to separate the tea leaves from prepared tea?
2. Suppose a mixture of sugar and fine powder of iron was given to you to separate. Which method would you apply? (Do little bit of research work)
3. When sugar is dissolved in water, the volume of water does not rise. Why?