CHAPTER: MATTER IN OUR SURROUNDINGS

Grade: **9**
Board: **CBSE**
Book: **NCERT**

1.

Chapter Summary and Placement

<Read through the following to understand how this chapter is connected with the previous and next grades and also the important concepts covered in it.>

1. In this chapter the student shall be introduced to the concept of matter and its different states - solids, liquids and gases.
2. This chapter also explain how different states of matter can change its states by applying temperature or pressure (Melting, Vaporization, Condensation, Freezing, Sublimation and Deposition). The concept of evaporation and its comparison with boiling is also clearly described.
3. Since the chapter is focussed on the objects present in our surroundings, hence, those objects and some laboratory instruments are used in explaining the teaching plan.

2.

LEARNING OUTCOMES

<On completion of the chapter, students will be able to:>

1. Define matter
2. Understand Physical Nature of Matter
3. Explain the Characteristics of Particles of Matter
4. Describe different states of matter
5. Understand how matter can change its state.
6. Define evaporation and its comparison with boiling
7. Understand factors affecting evaporation
8. Explain that evaporation causes cooling

3. KEYWORDS

Definitions of some terms used in the chapter:

Matter: Anything that has mass and occupies space.

Diffusion: Intermixing of particles of two different types of matter on their own.

Sublimation: The process of changing of gaseous state directly to solid state without going through liquid state, and vice versa.

Boiling: The process of conversion of whole liquid into its vapour state.

Evaporation: The process of conversion of liquid only on the surface into its vapour state.

3. TEACHING PLAN

Follow this section for getting ideas on teaching the content covered in the chapter. The subtopic given in the first column with the matching learning outcome can be explained using instructions and resources listed subsequently

Subtopic and Learning Objective #1

Matter and Its Physical Nature

1. Define matter
2. Understand Physical Nature of Matter

Teacher Activity

1. Show the students different articles like box, pencil, pen, shirt etc. and make them understand what is matter.
2. Define “matter” to students. (Matter is anything that has mass and take up space like air, water, box etc.)
3. Perform Activity 1 to make students understand that matter is made up of particles which are very small.

Check your Understanding

a. What do you understand by matter? Give its two examples.
b. Mention a physical property of matter

Resources Suggested

Blackboard, chalk, box , pencil, water, pen, shirt etc. as shown in Resource 1.

Resource 1:



Air



Water



Box



Pencil



Shirt

Activity 1

Name of the activity – What is matter made up of?
Type of activity – Group/Demonstration
Use it for – Describing Physical nature of matter
Materials – Two beakers filled with water, blue ink, two empty beakers, spoon.

Procedure –

1. Depending on the class size, divide the students in groups of three or four.
2. Add eight drops of ink to a beaker filled with water. You can ask the students to see how ink dissolve in water.
3. Pour half the quantity of this solution of ink and water to another empty beaker and fill it with water. Students can see the colour of ink getting lighter.
4. Again pour half of this solution of ink and water to a third empty beaker and fill the remaining beaker with water. So, all three solutions of ink and water have different color.
5. This means particles of ink are very very small which get dissolved in different quantities of water.

You can mix ink and water in many other ways to show that matter is made up of very small/minute particles.

Subtopic and Learning Objective #2

Characteristics of Particles of Matter
Explain the Characteristics of Particles of Matter

Teacher Activity

1. Conclude from Activity 1 that particles of sugar/salt take up the space between particles of water. Hence, particles of matter have space between them. This is the first characteristic of particles of matter.
2. Perform Activity 2 to demonstrate another characteristic of particle of matter. (Particles of matter are continuously moving - They possess Kinetic energy.) Also describe diffusion to students. (Intermixing of particles of two different kinds of matter on their own.)
3. Perform Activity 3 to demonstrate third characteristic of particle of matter. (Particles of matter attract each other.)
4. ***Check your Understanding***

a. Why can you the smell the hot food from a distance while you can't smell the cold food or ice-cream kept at the same distance?

b. Compare between the force among the particles of a chair and those of water?

Resources Suggested

Blackboard, chalk

Activity 2

Name of the activity – Particles of matter are continuously moving.
Type of activity – Group/Demonstration
Use it for – Describing characteristic of particles of matter (Kinetic energy of particle of matter)
Materials – Two beakers: one filled with hot water and other filled with cold water, potassium permanganate crystals.

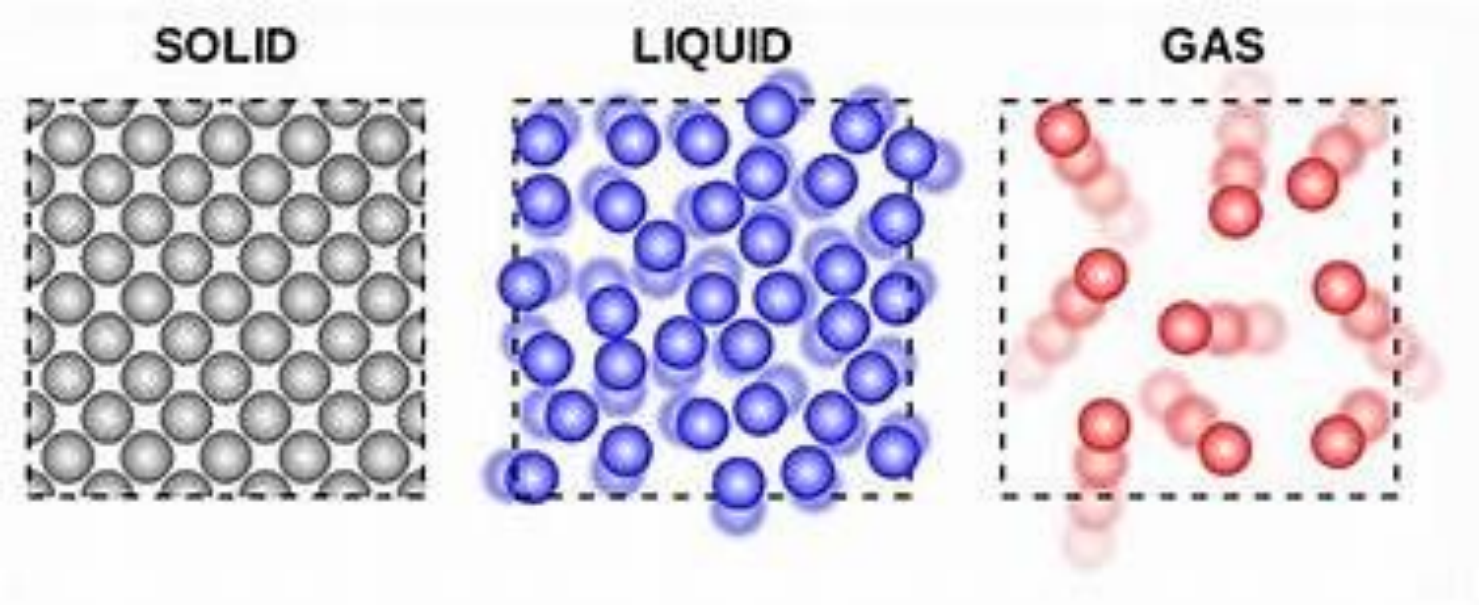
Procedure –

1. Depending on the class size, divide the students in groups of three or four.
2. Put a potassium permanganate crystal in a beaker of cold water. Ask the student to observe the mixing of crystal in between the particles of water.
3. SImilarly, put a potassium permanganate crystal in a beaker of hot water. Ask the students to observe the mixing of crystals in between the particles of water.
4. Let the students observe the two mixing processes and also differentiate between the two.
5. Conclude from the activity that particles of matter are continuously moving and as the temperature increases, particles move faster (Increase in temperature increases the kinetic energy of the particles).

Activity 3

Name of the activity – Particles of matter attract each other/They possess a force of attraction among them.
Type of activity – Group/Demonstration
Use it for – Describing characteristic of particles of matter (Force of attraction exists among the particles of matter.)
Materials – Chair, water in a beaker, balloon filled with air
Procedure –

1. Depending on the class size, divide the students in three groups.
2. One group can be asked to observe a chair, consider themselves its particles and stand as close as possible with their hands tightly locked with each other. (Refer the image below)
3. Other group can be asked to observe the beaker filled with water, consider themselves its particles and stand by holding each other's hands. (Refer the image below)
4. Third group can be asked to observe the balloon filled with air, consider themselves its particles and stand by holding each other's fingers. (Refer the image below)
5. Students of one group can be asked to compare the force of attraction among the particles of
6. Conclude from the activity that particles of matter possess force of attraction among themselves which differ in various substances as shown by the demonstration.


SOLID
LIQUID
GAS

Subtopic and Learning Objective #3

States of Matter
Describe different states of matter

Teacher Activity

1. Conclude from Activity 3 that different substances like chair, water and air filled in balloon represent three states of matter - solid, liquid, and gas.
2. Perform Activity 4 to understand more about solids, liquids and gases. Summarize the properties of different states of matter by showing them different articles and also making them recall their observations in previous activities. (Refer Resource 2)

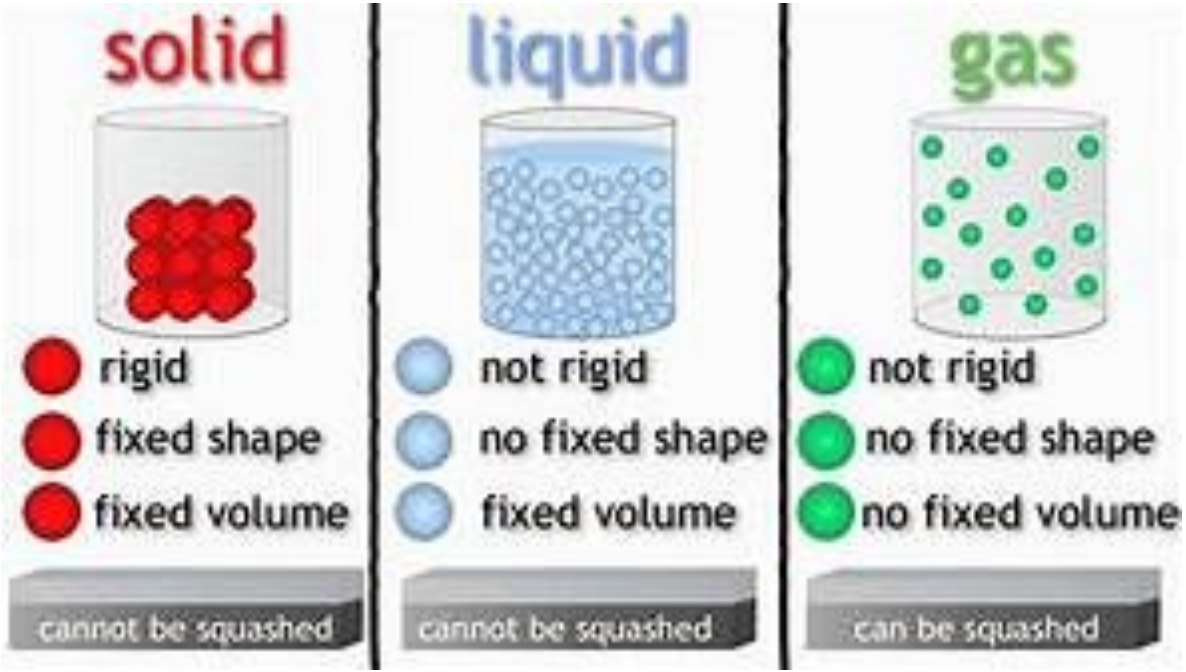
Check your Understanding

a. What is a fluid? Give examples.
b. Give one example of each solid, liquid and gas which can be dissolved in a liquid like water.

Resources Suggested

Blackboard, chalk, Different articles like - book, needle, wooden stick, oil, milk, juice, gas/air filled in balloon, Resource 2.

Resource 2:


solid
rigid
fixed shape
fixed volume
cannot be squashed
liquid
not rigid
no fixed shape
fixed volume
cannot be squashed
gas
not rigid
no fixed shape
no fixed volume
can be squashed

Activity 4

Name of the activity – Properties of Solids, Liquids, and Gases
Type of activity – Group/Demonstration
Use it for – Describing properties of three different states of matter.
Materials – Pencil, Table, Needle, Milk, Juice, Water filled in different shaped containers, Balloon filled with gas
Procedure –

1. Depending on the class size, divide the students in groups and show them these demonstration one by one.
2. Students can be asked to observe the objects like pencil, table and needle and ask them to fill the correct answers based on their properties in the observation table (shown below) on blackboard.
3. Next, students can be asked to observe the objects like milk, juice and water put in different containers and ask them to fill the correct answers based on their properties in the observation table (shown below) on blackboard.
4. Finally, students can be asked to observe the balloon filled in gas and ask them to fill the correct answers based on their properties in the observation table (shown below) on blackboard.
5. Conclude from the activity the properties of different states of matter.

Property	Solid	Liquid	Gas
Shape			
Volume			
Force of attraction of particles			
Space between particles			
Density = Mass/Volume			
Compressibility			

Subtopic and Learning Objective #4

Changes In States of Matter

Understand how matter can change its state by the effect of temperature and pressure

Teacher Activity

1. Show the students by lighting a candle, that its wax melts and change into liquid state. In the same way, matter can change its states
2. Show Activity 5 to students and clear the concept of changes in states of matter.
3. Summarize the changes in states of matter as seen by students in Activity 5 and use the image in Resource 3. Also explain the reverse process in the changes - Condensation (Gas to Liquid) and Freezing (Liquid to Solid).
4. Also, explain Sublimation (Solid to gas; no liquid state) and Deposition (Gas to solid; no liquid state) by showing Resource 3. (Ex: Ammonium chloride to its vapours)
5. As the changes occur in states of matter by increasing and decreasing temperature, in a similar way, changes in states of matter also occur by increasing and decreasing pressure as seen in Resource 3. (Liquefication of gases; Give examples: Carbon dioxide to solid carbon dioxide [dry ice])

Check your Understanding

a. Give examples of certain substances which undergo sublimation.
b. What will be formed when the pressure of carbon dioxide is reduced?

Resources Suggested

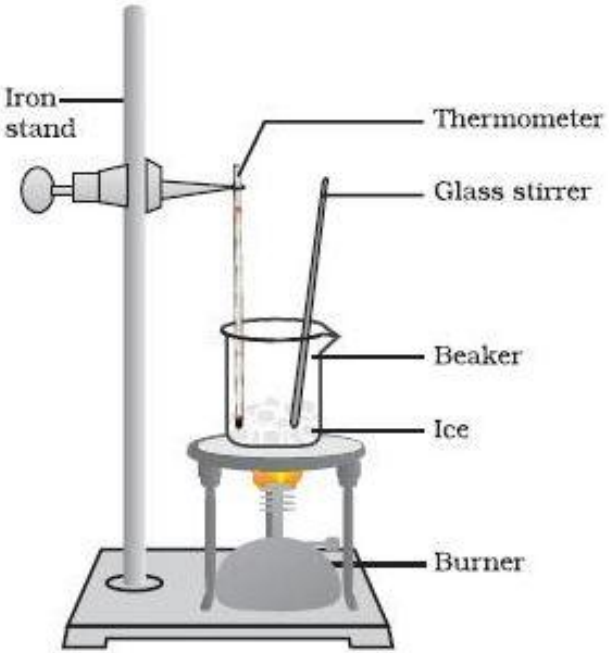
Blackboard, chalk, Candle, matchbox, Resource 3

Activity 5

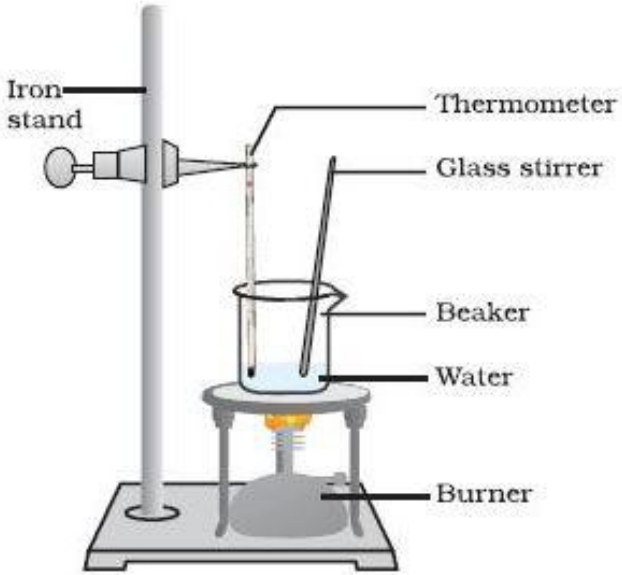
Name of the activity – How does matter changes its state?
Type of activity – Group/Demonstration
Use it for – Understanding the concept of change of state of matter by temperature.
Materials – Beaker, ice, water, laboratory thermometer, heating instrument of laboratory. (If the materials are not available, then it can be shown by drawing the diagram on blackboard.)
Procedure –

1. Divide the students in group according to the class size and show the demonstration to each of them.
2. Set up the instrument as shown in the diagram below.
3. Ask the students to observe the temperature of the ice by observing the thermometer carefully. Start the heating of ice kept in beaker in the set up as shown. As the temperature becomes 273K, the ice starts changing into water. (This temperature of 273K or 0°C is called as Melting point.) (Recall the conversion of temperatures from Celsius to Kelvin and vice versa, which the students have studies in previous classes.) More heat is provided to the beaker, but the temperature remains same till all the ice melts. (The heat required by the ice in the process of melting/fusion which doesn't change the temperature is called as latent heat of melting. The word "latent" means hidden.)

4. So, after all the ice melts, heat is further provided and the temperature again starts increasing.
5. The temperature increases and as it becomes 373K, the water starts changing into gas. (This temperature of 373K or 100°C is called as Boiling point.) More heat is provided to the beaker, but the temperature remains same till all the water boils. (The heat required by water in the process of boiling/vaporisation which doesn't change the temperature is called as latent heat of vaporisation.)
6. Conclude the activity by defining latent heat of melting and latent heat of vaporization

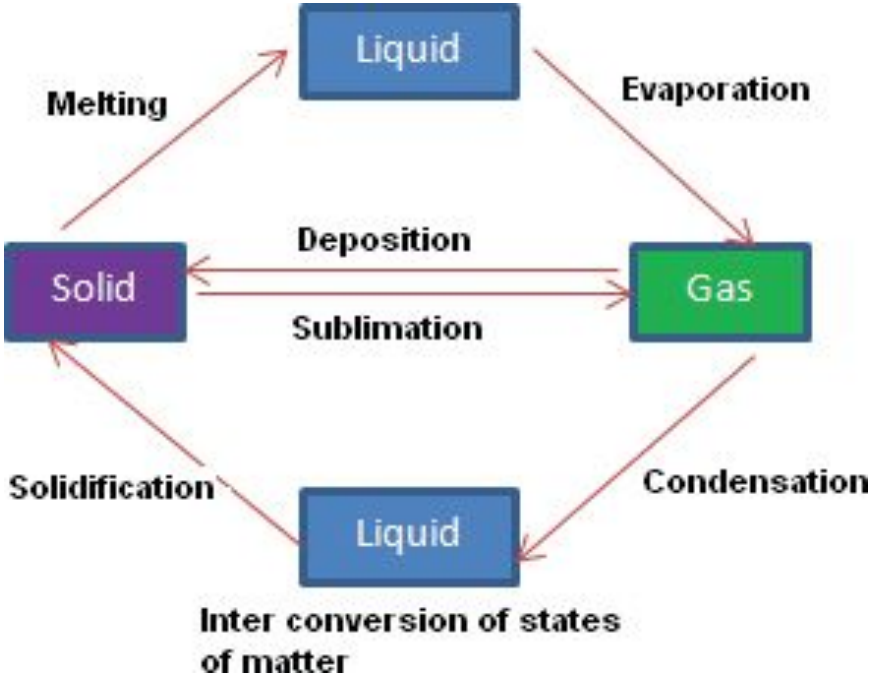

Iron stand
Thermometer
Glass stirrer
Beaker
Ice
Burner

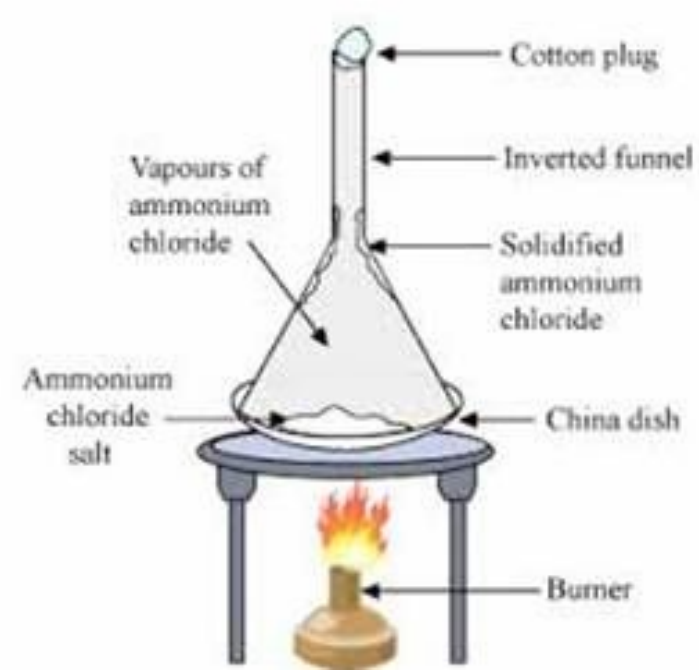
(a)


Iron stand
Thermometer
Glass stirrer
Beaker
Water
Burner

(b)

Resource 3:


Liquid
Melting
Evaporation
Deposition
Solid
Gas
Sublimation
Solidification
Condensation
Liquid
Inter conversion of states of matter


Cotton plug
Inverted funnel
Vapours of ammonium chloride
Solidified ammonium chloride
Ammonium chloride salt
China dish
Burner

Subtopic and Learning Objective #5

Evaporation
Define evaporation and its comparison with boiling
Understand factors affecting evaporation
Explain that evaporation causes cooling

Teacher Activity

1. Put/Hang the wet cloth under sun or in front of table fan. Show the students that wet cloth starts getting dry without the temperature of water reaching to its boiling point (100°C).
2. Make students recall that water gets converted to vapours in water cycle which they have studied in previous classes (which is not termed as boiling). Introduce the concept of evaporation to students. (change of a liquid into vapours at any temperature below its boiling point)
3. Summarize the differences between evaporation and boiling as shown in Resource 4.
4. Perform Activity 6 to understand different factors affecting evaporation.
5. Perform Activity 7 to understand that Evaporation causes cooling

Check your Understanding

a. Give differences between evaporation and boiling.
b. Why do we wear cotton clothes in summer

Resources Suggested

Blackboard, chalk, a wet cloth, cloth hanging rope, Table fan, Resource 4.

Activity 6

Name of the activity – Factors Affecting Evaporation
Type of activity – Group/Demonstration
Use it for – Understanding the concept of factors affecting evaporation
Materials – Wet Clothes, Cloth hanging rope, equal quantity of water in 2 containers,

Procedure –

1. Divide the students in group according to the class size and show the demonstration to each of them.
2. Put/hang a wet cloth on the rope under the sun and another in a shady area. Ask students to observe their drying in both the condition and deduce the conclusion. (More the temperature of the surrounding, more will be the evaporation)
3. Put some quantity of water in a glass under the Sun and spread the same quantity of water on the floor under the Sun and ask the students to observe and compare the rate of evaporation in the two cases. (More the surface area, more will be the evaporation)

4. For showing, how humidity affects the rate of evaporation, make students first recall what is humidity (the amount of water vapour in atmosphere) and then explain it how it affects the rate of evaporation. (Cannot be shown in the demonstration.)
5. Put/hang a wet cloth on the rope under the sun at a place where there is wind and the other where there is no wind. Ask students to observe their drying in both the conditions and deduce the conclusion. (More the wind speed, more will be the evaporation). (If the day is not windy, you can use a table fan and ask students to imagine that way.)

This ways you can conclude various factors affecting evaporation.

Activity 7

Name of the activity – Factors Affecting Evaporation
Type of activity – Group/Demonstration
Use it for – Understanding the concept evaporation causes cooling
Materials – Beaker filled with ice (Ice should be just taken out of the freezer),

Procedure –

1. Divide the students in group according to the class size and show the demonstration to each of them.
2. Show the students that when ice is filled in a beaker and is kept for sometime. They can observe the water droplets forming outside the beaker.
3. Explain the observation to the students. (Water vapour of the atmosphere gets cooled on the cold surface of the beaker.)

Hence, you can conclude that evaporation causes cooling. With the same conclusion you can also clear the reason as to why we prefer wearing cotton clothes in summer.

Resource 4:

Boiling	Evaporation
A process in which a substance changes its state from the liquid state to the gaseous state	Evaporation is a process whereby the water changes into vapour without boiling
Quick	Slow
Bubbles are formed	No bubbles formed
Occurs throughout the liquid	Takes place only from the exposed surface of the liquid
Occurs at a definite temperature --- boiling point	Occurs at all temperatures
Source of energy needed	Energy supplied by surroundings

4. WORKSHEETS

Print or copy the worksheet questions on the blackboard and ask the students to attempt them. They can be given as homework or a class test as well.

Worksheet 1

Use it like: test after introduction of photosynthesis, homework, class assignment

Answer the following questions in brief:

1. Answer the following:
   a) Why do people prefer sprinkling water on roof or on the open ground on a hot sunny day?
   b) What do we observe or feel when we put nail polish remover on you palm?
2. List down the factors which affect the rate of evaporation.
3. What will happen when we heat the following:
   a) Ammonium chloride
   b) Wax of a candle
4. Give two points of differences between air and spoon (on the basis of density and compressibility)?
5. Can solids and gases diffuse in liquids? Give examples.
6. Mention two characteristics of particles of matter.

Worksheet 2

Use it like: checking students understanding in class, oral test

Multiple choice questions:

1. Which of the following is NOT true for solids?

a) Definite shape
b) Definite volume
c) High compressibility
d) Higher density than liquids and gases

2. State whether the following statement is true or false.
When we decrease the pressure of carbon dioxide, it changes into liquid carbon dioxide.

a. True
b. False

3. When the ice melts, the temperature _____.
a. decreases gradually from 0°C
b. increases gradually from 0°C
c. remains at 0°C
d. decreases gradually to 0°C

4. Which of the following states of matter has the most ordered arrangement of particles?
a. Solid
b. Liquid
c. Gas
d. Solid and Liquid

5. Which of the following show high rate of diffusion among its particles?
a. Solid
b. Liquid
c. Gas
d. Solid and Liquid

6. Which of the following is NOT a property of gas?
a. Maximum interparticle space
b. Minimum interparticle force of attraction
c. Least density
d. Definite volume

7. Which of the following processes is the opposite of sublimation?
a. Melting
b. Freezing
c. Deposition
d. Condensation

8. Water cooler cools better on a _____ day.
a. hot and dry
b. humid
c. rainy
d. cold

9. Which of the following is the correct increasing order of density?

a) Iron < Water < Honey < Oxygen

b) Honey < Water < Oxygen < Iron

c) Iron < Honey < Water < Oxygen

d) Oxygen < Water < Honey < Iron

10. The melting point of ice is _____.

a. 0°C

b. 100°C

c. 0 K

d. 373 K

Worksheet 3

Use it like: after Activity 2, classwork

Answer the following tricky questions as given below:

1. **You can compress me. What is my name? Am I a solid?**



2. You can change my shape? What is my name? Am I a liquid?



5. SOLUTIONS

This section gives you sample answers for activities and questions listed above.

Worksheet 1

1. a. By sprinkling water on roof or on the open ground helps to cool the surface as the latent heat of vaporisation is high for water.

   b. When we put nail polish remover on our palm, its particles gain energy from our palm or surroundings and evaporate causing our palm to feel cool.

2. The factors which affect the rate of evaporation are as follows:
   a) Temperature
   b) Humidity in surroundings
   c) Surface area
   d) Wind speed
3. a) When we heat ammonium chloride, it changes into its vapours.

   b) When we heat wax of the candle, it melts.

4. The differences between between air and spoon are as follows:

Property	**Air**	**Spoon**
Density	Less density	More density
Compressibility	High compressibility	Less compressibility

5. Yes, solids and gases can diffuse in liquids. For example, solids like sugar and salt can diffuse in water. Another example gases like oxygen and carbon dioxide diffuse in water.
6. The two characteristics of particles of matter are as follows:
   a) Particles of matter are continuously moving.
   b) Particles of matter attract each other.

Worksheet 2

1. High compressibility
2. b) - False
3. c) - remains at 0°C
4. a) - Solid
5. c) - Gas
6. d) - Definite volume
7. c) - Deposition
8. a) - hot and dry
9. d) - Oxygen < Water < Honey < Iron
10. a) - 0°C

Worksheet 3

1. You are a sponge. Yes, you are a solid because you have a definite shape and volume. A sponge has minute holes in it in which air is trapped. When we press a sponge, air is expelled out and hence we are able to compress the sponge.

2. A rubber band changes shape under force and regains the same shape when the force is removed. If excessive force is applied, the rubber band breaks

6. EXTRA RESOURCES

Carry out the following suggested activities/ tasks if you have the time and resources to do them

1. **Video Links:**

Show the following videos to the students on computer/ tablet/ screen:

a) States of Matter
https://www.youtube.com/watch?v=mpufi-1voVo

b) Changes in states of matter
https://www.youtube.com/watch?v=ENVKQVIDNLY

2. **Extension Activity 2:**
Purpose: To show factors on which evaporation depends
Design an activity to demonstrate how the rate of evaporation depends on various factors. Think about the various factors like humidity, temperature, wind speed and design an experiment to demonstrate the same.