

PERIOD 8 AND 9

Movement of particles in different states of matter

Teacher guided discussion

Explain that particles of liquids are in continuous motion and collision causes spreading. Explain everyday examples such as the spread of smell, expansion of balloons, and fizz in aerated drinks to understand that gas particles are always in motion. Explain how this movement allows gases to spread easily and occupy available space. Explain the comparison between solids, liquids, and gases by highlighting differences in particle spacing, force of attraction, and freedom of movement.

Using Resources

Conduct the activities 7 and 8 to understand the movement of particles in liquid and gas.

Suggested home assignment

Explain in two lines why potassium permanganate crystal spreads faster in hot water than in cold water.

PERIOD 10

Revise all the topics covered in the previous lesson.

Using Resources

Refer to the corresponding chapter in the Digital Support given in the book.

PERIOD 11

Discuss the exercises given at the end of the chapter.

PERIOD 12

Assessment of understanding of the chapter could be done with the help of the given worksheet for the chapter.

TEXT BOOK ANSWERS

Objective Type Questions

1. Name the following:

- | | | |
|------------------------|-------------------------|-----------------|
| (a) atoms or molecules | (b) Interparticle space | (c) Solid state |
| (d) Liquid state | (e) Boiling | (f) Fluids |

2. Fill in the following blanks with suitable words:

- | | | |
|------------|-----------------|-------------------|
| (a) matter | (b) melting | (c) boiling point |
| (d) solid | (e) liquid, gas | |

3. State whether the following statements are true or false:

- | | | |
|----------|----------|-----------|
| (a) True | (b) True | (c) True |
| (d) True | (e) True | (f) False |

Subjective Type Questions

Short Answer Type Questions

1. A substance is called matter if
 - It has mass.
 - It occupies space.
2. This observation shows that particles of matter have spaces between them. The sugar particles occupy the spaces between water particles, so the volume does not increase.
3. The state of a substance (solid, liquid or gas) is decided by the properties of its particles. These include the space between the particles, the force of attraction between the particles, and the thermal energy of the particles.
4. Gases mix easily because their particles have large interparticle spaces and very weak force of attraction, allowing free movement. Solids have very strong forces of attraction and tightly packed particles, so they do not mix easily.
5. (a) Maximum movement of particles: Gases
(b) Maximum interparticle attractions: Solids
(c) Minimum spaces between particles: Solids
6. Two properties each of solid, liquid and gas are:

Solids	Liquids	Gases
Fixed shape	No fixed shape	No fixed shape
Fixed volume	Fixed volume	No fixed volume

7. The gas particles from the incense stick move freely and mix with air particles, spreading the smell throughout the room.
8. Salt dissolves completely in water, and its particles spread uniformly throughout the water. Although the salt particles are not visible, they are present, giving the ocean water a salty taste.
9. Oxygen < Water < Sugar
(Oxygen has the least force of attraction and sugar has the maximum.)

Long Answer Type Questions

1. Materials:

Water, beaker, glass tumbler, conical flask, flat-bottomed flask, marker

Procedure:

- Take some water in a beaker and mark the water level. Observe that the water takes the shape of the beaker.
- Pour the water from the beaker into a glass tumbler. Notice that the water now takes the shape of the tumbler.
- Next, pour the water into a conical flask. The water adjusts and takes the shape of the conical flask.

- Finally, pour the water into a flat-bottomed flask. Observe that the water takes the shape of the flat-bottomed flask.

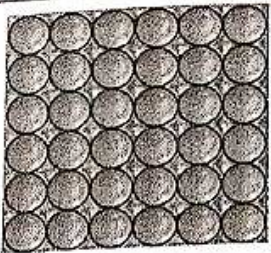
Observation:

- In each container, the water changes its shape to match the container.
- However, when the water is poured back into the original beaker, it reaches the same marked level, showing that the volume has not changed.

Conclusion:

- Liquids do not have a fixed shape; they take the shape of the container.
- Liquids have a fixed volume that remains constant even when the shape of the container changes.

2. (a) A picture representing particles present in the following:

(i) Aluminium foil	(ii) Glycerine	(iii) Methane gas
		

- (b) **Solid wax:** This is the main body of the candle. Its particle arrangement would match the diagram of tightly packed, ordered particles.

Liquid wax: This is the small pool of melted wax at the base of the wick. Its particle arrangement would match the diagram of closely packed but disordered particles.

Gaseous wax: This is the trail of smoke or vapour rising from the hot wick. Its particle arrangement would match the diagram of particles that are very far apart and moving randomly.

3. **Melting:** When a solid is heated, its particles start vibrating faster. On continuous heating, these vibrations become stronger and the particles gain enough energy to overcome the interparticle force of attraction. As a result, the particles leave their fixed positions and the solid changes into a liquid. This process is called melting. The temperature at which a solid changes into a liquid at atmospheric pressure is called its melting point. For example, ice melts at 0°C to form water.

Boiling: When a liquid is heated, its particles gain more and more energy. At a particular temperature, called the boiling point, the particles gain sufficient energy to completely overcome the interparticle force of attraction. The particles then escape from the liquid and change into a gas. This process is called boiling. For example, water boils at 100°C to form steam at atmospheric pressure.

4. (a) Gas particles move freely in all directions and are far apart. Because of their continuous motion, they spread out and occupy the entire space available in the vessel.
- (b) In gases, the particles are far apart, so there is a lot of empty space between them. When a force is applied, the particles can be pushed closer together, making gases easily

compressible. In solids and liquids, the particles are already very close, so there is very little space to reduce further. That's why solids and liquids are almost incompressible.

Multiple Choice Questions (MCQ)

1. (b) kerosene
2. (c) gases and liquids behave as fluids
3. (d) closely packed in solids and move past each other in liquids
4. (c) oxygen, water, sugar
5. (c) oxygen
6. (b) particles in a liquid are arranged in a regular pattern
7. (c) the particles of bromine are moving but those of air are not moving
8. (b) matter is made up of tiny particles too small to be seen
9. (b) gas particles are far apart with large spaces
10. (b) the smell of cooked food spreading through the air
11. (c) liquids have fixed volume but no fixed shape
12. (c) salt particles fill the spaces between water particles
13. (a) particles are tightly packed and vibrate in place

21st Century Skills

1. (a) Contents of jars A and B

- Jar A: Solid iodine which turns to purple vapour on heating.
- Jar B: Air

(b) When the glass plate is removed, the particles of the solid in jar A start spreading into jar B. Gradually, the air in jar B also gets affected, and the substance spreads throughout both jars.

(c) This experiment shows the movement of particles of matter. It proves that particles of matter are in constant motion and can spread from one place to another.

2. Water is a liquid in which the particles have weaker forces of attraction and can move past one another, so it flows easily and allows us to swim through it. A brick is a solid in which the particles are very closely packed and have strong forces of attraction. Due to this strong interparticle force, a brick is rigid and difficult to break.

3. (a) When the balloon is kept in sunlight, the air inside it gets heated. On heating, air particles gain energy and move faster, increasing the pressure inside the balloon. This increased pressure causes the balloon to burst.

(b) This demonstrates that particles of matter are in constant motion and that gases expand on heating.

(c) If the balloon is placed in a refrigerator, the air inside it cools down. The particles move more slowly and the pressure inside decreases, so the balloon shrinks slightly.

BE CURIOUS

Research about Brownian motion, and how it supports the idea of moving particles. Look up the discovery by Robert Brown and what it tells us about particle movement in liquids and gases, and create a report on it.

Research Based Analytical Thinking

REVISIT

Answer the following questions.

- What is the space between particles of matter called?
- Are liquids easily compressible?
- What makes up Suspended Particulate Matter?
- What increases with temperature in all states?
- What do two hydrogen atoms make?

Understanding

KEY TERMS

Matter: Anything that has mass and occupies space

Constituent particles: Tiny particles like atoms, molecules, or ions making up matter

Interparticle spaces: Spaces between particles, smallest in solids and largest in gases

Interparticle forces: Forces of attraction that hold particles together

Atom: The smallest unit of matter that retains the properties of an element

Molecule: Formed by the combination of atoms of the same or different elements

- **Solid:** State of matter with fixed shape and volume, particles are closely packed
- **Melting point:** Temperature at which solid changes to liquid at atmospheric pressure
- **Liquid:** State of matter with fixed volume but no fixed shape, particles less tightly packed than solids
- **Soluble substance:** A substance that dissolves in a liquid by occupying spaces between particles
- **Insoluble substance:** A substance that does not dissolve and settles down at the bottom
- **Gas:** State of matter with neither fixed shape nor fixed volume, particles are far apart and moving freely
- **Suspended Particulate Matter (SPM):** Dust and smoke particles suspended in air
- **Thermal energy:** Heat energy that affects the movement of particles
- **Evaporation:** Conversion of liquid to vapour below the boiling point of the liquid
- **Boiling point:** Temperature at which liquid turns to vapour throughout at the atmospheric pressure
- **Fluid:** Substance that can flow, including liquids and gases

Quick **RECAP**



- Materials have characteristics like colour, texture, hardness, and weight that help identify and differentiate them.
- Matter is made of tiny particles called atoms, molecules, or ions.
- Interparticle spaces exist between particles; smallest in solids, and largest in gases.
- Particles are held by interparticle forces of attractions, determining matter's physical properties and states.
- Acharya Kanad proposed the concept of *Parmanu* (atoms) over 2600 years ago.
- Solids have tightly packed particles with strong interparticle forces of attractions; fixed shape and volume; particles vibrate about their fixed positions.
- Different solids have different melting points based on interparticle force strength.
- Liquids have particles less tightly packed than solids; definite volume but no fixed shape.
- Liquids allow soluble substances to occupy spaces between their constituent particles; insoluble substances settle down.
- Gases have widely spaced constituent particles with negligible forces of attractions; no fixed shape or volume; but highly compressible.
- Particle movement increases with heat; particles of solids vibrate, liquids flow, gases move rapidly in all directions.
- Sugar dissolves in water as its particles occupy the space available between the particles of water.

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Particulate Nature of Matter | 135

3. Gases are highly _____ because particles have large spaces between them.
4. The space between particles of matter is called _____.
5. Liquids have a fixed _____ but no fixed shape.

C. State True or False.

1. Gases have a fixed volume and shape.
2. Sand settles at the bottom when added to water.
3. Thermal energy increases the movement of particles in solids.
4. Compression of gases is difficult due to closely packed particles.
5. Evaporation occurs throughout the liquid, forming bubbles inside.

D. Match the following.

Column I

1. Matter
2. Thermal energy
3. *Parmanu*
4. Molecule
5. Boiling point

Column II

- a. Ancient term for atom by Acharya Kanad
- b. Combination of two or more atoms
- c. Anything that has mass and occupies space
- d. Temperature at which liquid turns into vapour
- e. Energy that affects movement of particles

E. Give one word for the following.

1. Dust Particles found in the air
2. Liquids and gases are called
3. Takes the shape of each container, but its volume remains unchanged
4. Slow process of vapour formation
5. Substances that do not dissolve in a liquid

F. Assertion Reason Questions

The following questions consist of an Assertion (A) and a Reason (R). Read the Assertion and Reason and choose the appropriate answer.

- a. Both A and R are true and R is the correct explanation of A.
- b. Both A and R are true but R is not the correct explanation of A.
- c. A is true but R is false.
- d. A is false but R is true.

1. **Assertion (A):** Liquids have a fixed shape but have no fixed volume.

Reason (R): Particles in solids are more tightly packed than liquids.

Analytical Thinking

2. **Assertion (A):** Melting point depends on interparticle forces of attractions.
Reason (R): Stronger forces of attraction mean higher melting points.
3. **Assertion (A):** Sugar dissolves in water because sugar particles occupy spaces between water particles.
Reason (R): Sand also dissolves in water.
4. **Assertion (A):** When a solid melts, it absorbs energy.
Reason (R): Particles gain energy to overcome attraction forces.

G. Case/Paragraph Based Questions

Application Based

Read the given passage and answer the following questions.

When heat is added to a substance, its particles start moving faster, sometimes causing changes in the state. For example, a solid may transform into a liquid when its particles gain sufficient energy to overcome their strong forces of attraction, reaching what is called a melting point. Further heating of a liquid leads to vapour formation throughout, known as boiling. However, even before boiling, a liquid loses particles slowly from its surface in a process called evaporation. The rate of these processes depends not just on temperature but also on particle movement and intermolecular forces.

1. What is the temperature at which solids turn into liquids?
 - a. Boiling point
 - b. Freezing point
 - c. Melting point
 - d. Sublimation point
2. Boiling differs from evaporation because boiling
 - a. occurs at the surface only
 - b. requires less heat
 - c. happens throughout the liquid
 - d. happens slower than evaporation.
3. The process where liquid converts to vapour from its surface is known as
 - a. melting
 - b. evaporation
 - c. condensation
 - d. boiling.
4. Increasing heat generally causes particles to
 - a. slow down
 - b. move faster
 - c. stay still
 - d. disappear.

H. Very Short Answer Type Questions

1. Name the very tiny particles that make up all the matter.
2. At what temperature does ice melt to become water?
3. Which philosopher first proposed the concept of *Parmanu* (atom)?
4. What is the ability of liquids and gases to flow called?
5. In which state particles vibrate but do not move from their fixed positions?



I. Short Answer Type Questions

1. How do interparticle spacing and forces affect the properties of solids, liquids, and gases?
2. Why are gases compressible?
3. Explain why liquids take the shape of their container but solids do not.
4. What distinguishes evaporation from boiling?
5. How do soluble and insoluble substances behave differently in liquids?

J. Long Answer Type Questions

1. Describe the arrangement and motion of particles in solids, liquids, and gases.
2. How does heating affect the movement of particles in solids, liquids, and gases?
3. What role does particle movement play in the cleaning action of soap?
4. What causes the fragrance of an incense stick to spread rapidly in a room?

K. Picture Based Question

Observation Based

Observe the given states of matter and complete the following table.

		
Interparticle spacing is _____.	Interparticle spacing is _____.	Interparticle spacing is _____ than in solids.
Particles are _____.	Particles are _____ packed.	Particles are _____ closely packed than in solids.
Interparticle attraction is _____.	Interparticle attraction is _____.	Interparticle attraction is _____ than in solids.
Particles move in _____ the available space.	Movement of particles is _____.	Movement of particles is restricted to _____ space.

HOTS (HIGHER-ORDER THINKING SKILLS)

Problem Solving
Critical Thinking



1. How the diffusion rate of perfume fragrance differ in a cold room compared to a hot room?
2. What will happen if we increase the pressure on a gas and simultaneously decrease the temperature?

ACTIVITY ZONE

- A. Using cotton balls, coloured beads, or marbles, create a wall-mounted collage or poster that shows how particles are arranged in solids, liquids, and gases. Include arrows to indicate motion and spacing. Display your model and explain how the arrangement changes with temperature and interconversion among states of matter. **Creativity** **Art Integration**
- B. Set up a 'classroom thought wall or notice board' with two columns labelled: "Helpful Effects of Gas Expansion" and "Harmful Effects of Gas Expansion." Think of real-life situations such as airbags in cars, bursting pressure cookers, or inflating sports balls. Write your ideas on sticky notes and place them under the appropriate column. Discuss how gas behaviour can be both useful and dangerous. **Analytical Thinking** **Experiential Learning**

Investigatory PROJECT

Find out how astronauts breathe in space. Research what kind of gases are present inside a spacecraft and how oxygen is stored and recycled. Prepare a short report or presentation on the role of gases in space missions. **Computational Thinking** **Research Based**

LIFE SKILLS

We should avoid releasing harmful gases indiscriminately since gases spread and mix quickly due to particle motion, meaning pollutants can easily contaminate the air, harming human health and the environment. **Life Skills and Values**

Teacher's NOTE

Begin the chapter by explaining that matter makes up everything around us and is made of tiny particles. Use simple activities like breaking chalk and dissolving sugar to show the particle nature. Teach solids, liquids, and gases through visuals and experiments with melting and boiling. Include stories of atomic theory for interest and encourage discussions to connect concepts with daily life.