

Primary 6 Science — States of Matter

Topic Note | Unit 3: Weather, Air and Diffusion | For teachers and learners

1. Key Terms

- **Matter** — anything that occupies space and has mass.
- **Solid** — a state of matter with a fixed shape and a fixed volume.
- **Liquid** — a state of matter with a fixed volume but no fixed shape; it takes the shape of its container.
- **Gas** — a state of matter with no fixed shape and no fixed volume; it spreads to fill its container.
- **Mass** — the amount of material that makes up a substance.
- **Melting** — the change from solid to liquid, caused by heating.
- **Freezing** — the change from liquid to solid, caused by cooling.
- **Evaporation** — the change from liquid to gas, caused by heating.
- **Condensation** — the change from gas to liquid, caused by cooling.
- **Sublimation** — the change from solid directly to gas, without passing through a liquid stage.

2. Explanation

2.1 What is matter?

Everything around you — a stone, water, the air you breathe, a book — is made of matter. Matter is anything that occupies space and has mass. If something takes up room and can be weighed, it is matter. Matter exists in three common states: solid, liquid and gas. Which state a substance is in depends on its temperature and the pressure around it.

2.2 The three states of matter

The difference between a solid, a liquid and a gas comes down to how tightly packed their particles are and how freely those particles can move.

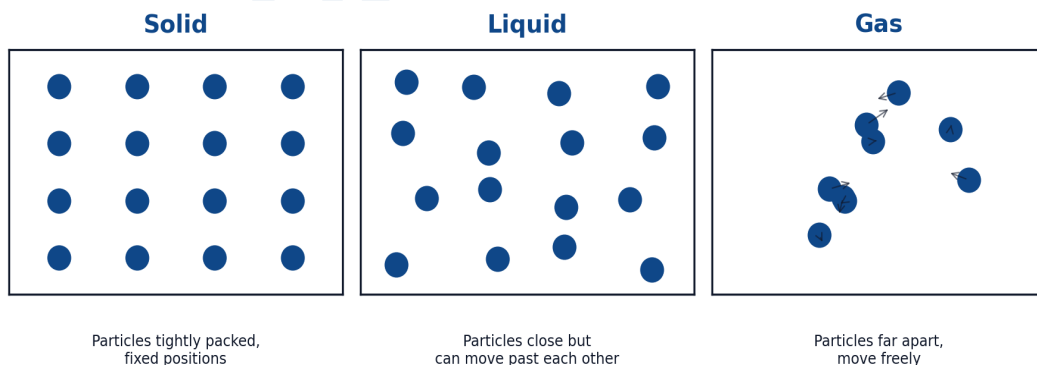


Diagram 1 — How particles are arranged in a solid, a liquid, and a gas.

Solids have a definite shape and a fixed volume. Their particles are packed tightly together in place, so a solid keeps its shape no matter what container it is placed in. Examples: a stone, a bottle, a piece of wood, a grain of sugar.

Liquids have a fixed volume but no fixed shape — they take the shape of whatever container they are poured into, and they can flow. Examples: water, cooking oil, juice.

Gases have no fixed shape and no fixed volume. Their particles are far apart and move freely, so a gas spreads out to fill the whole space available to it, and can also be compressed into a smaller space. Examples: the air in a balloon, the air we breathe.

2.3 Summary of properties

State	Mass	Volume	Shape
Solid	definite	definite	definite
Liquid	definite	definite	indefinite
Gas	definite	indefinite	indefinite

Notice that mass is definite in all three states — solids, liquids and gases all have mass, even though we cannot always feel the mass of a gas.

2.4 Effect of heat on matter

Matter can change from one state to another when it is heated or cooled. The particles either gain energy and spread apart (heating) or lose energy and pack closer together (cooling).

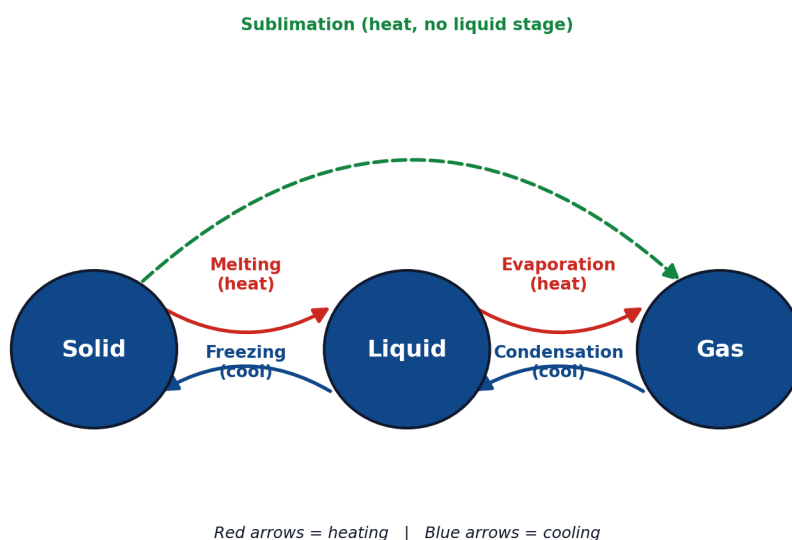


Diagram 2 — The cycle of changes between solid, liquid and gas.

- **Melting** — heating changes a solid into a liquid (e.g. ice into water).
- **Freezing** — cooling changes a liquid into a solid (e.g. water into ice).
- **Evaporation** — heating changes a liquid into a gas (e.g. water into water vapour).
- **Condensation** — cooling changes a gas into a liquid (e.g. steam into water droplets).

2.5 Sublimation — a special case

Most substances go solid → liquid → gas in that order as they are heated. A few substances skip the liquid stage entirely and pass straight from solid to gas. This is called sublimation. Solid carbon dioxide ("dry ice") is a well-known example: left in a warm room, it turns straight into gas without ever forming a puddle.

In general: increasing temperature causes melting and evaporation. Decreasing temperature causes condensation and freezing.

3. Examples

Example 1 — Classifying matter

A cooking pot, milk, and the air inside a football. Classify each as solid, liquid or gas.

Cooking pot — solid (keeps its own shape).

Milk — liquid (takes the shape of its container, flows).

Air in a football — gas (spreads to fill the ball, can be compressed).

Example 2 — Predicting shape change

Cooking oil is poured from a bottle into a round bowl, then into a square dish. What happens to its shape? What happens to its volume?

The oil takes the shape of the bowl, then the shape of the dish – its shape changes each time. Its volume (the actual amount of oil) stays the same throughout, because liquids have a fixed volume.

Example 3 — Melting and freezing

A block of butter is left in the sun and turns soft and runny. Later it is put in a fridge and turns solid again. Name the two processes.

Solid → liquid in the sun: melting (heating).

Liquid → solid in the fridge: freezing (cooling).

Example 4 — Evaporation and condensation

A wet cloth is hung outside and dries by afternoon. That evening, water droplets form on the outside of a cold glass of juice. Name the two processes.

Wet cloth drying: evaporation – the water in the cloth changes to water vapour and escapes into the air.

Droplets on the cold glass: condensation – water vapour in the air touches the cold glass, cools, and changes back into liquid water.

Example 5 — Sublimation

A small block of dry ice is left on a table in a warm classroom. After some time it has completely disappeared, with no puddle of liquid left behind. Explain what happened.

The dry ice changed directly from a solid to a gas (carbon dioxide gas), without passing through a liquid stage. This is sublimation.

4. Practice Questions

1. Name the three states of matter.
2. Classify the following into solid, liquid or gas: cooking oil, a wooden spoon, the air in a football.
3. Name the process by which a liquid changes into a gas.
4. Fill in the blank: When a block of ice is left in the sun, it _____ into water.
5. Which of these has no fixed shape and no fixed volume: a brick, milk, or the air we breathe?
6. Explain why water droplets form on the outside of a cold cup of juice on a hot day.
7. A block of dry ice placed in a warm room disappears completely without ever forming a puddle of liquid. Name this process and explain, in your own words, why it is unusual.
8. Complete the definition: Matter is anything that _____ and has _____.

5. Answers

1. Solid, liquid, and gas.
2. Cooking oil — liquid. Wooden spoon — solid. Air in a football — gas.
3. Evaporation.
4. melts
5. The air we breathe.
6. Water vapour in the warm air touches the cold surface of the glass, cools down, and condenses back into liquid water droplets.
7. Sublimation — it is unusual because the dry ice changes directly from a solid to a gas, skipping the liquid stage that most substances pass through.
8. occupies space; mass