

# MATTER IN OUR SURROUNDINGS

CBSE CLASS 9 SCIENCE • CHAPTER 1 • HIGH-YIELD REVISION BOOKLET

## 1. Introduction & Importance of Matter

Everything around us that occupies space and possesses mass is defined as **matter**. It constitutes the physical fabric of our environment, ranging from basic survival elements to everyday compounds.

### Standard Examples:

- Air & Oxygen
- Water & Milk
- Stone & Wood
- Carbon Dioxide

### Daily Life Relevance:

- Respiration relies completely on air.
- Biological survival requires water.
- Infrastructure is built from physical matter.
- Food provides biochemical energy.

## 2. Core Characteristics of Particles of Matter

Matter is particulate rather than continuous, composed of incredibly minute particles possessing distinct structural properties.

### Characteristic 1: Particles of Matter are Extremely Small

**Experimental Verification:** Dissolve a single crystal of potassium permanganate ( $\text{KMnO}_4$ ) in 100 mL of water. Take 10 mL of this solution and dilute it into another 90 mL of clear water. Repeat this process 5 to 8 times.

**Observation & Inference:** The water remains distinctly colored even after extreme dilution. This proves that a single crystal contains millions of tiny particles that divide themselves continuously.

### Characteristic 2: Particles of Matter Have Intermolecular Space

**Experimental Verification:** Measure a fixed volume of water in a calibrated beaker and mark the level. Dissolve a spoonful of sugar or salt into it using a glass rod.

**Observation & Inference:** The sugar dissolves completely, but the overall water level does not show any noticeable rise. This indicates that sugar particles position themselves comfortably inside the empty spaces between the water molecules.

### Characteristic 3: Particles of Matter are Continuously Moving

**Real-World Evidence:** When a bottle of perfume is opened or an incense stick is lit in one corner of a closed room, its fragrance spreads across the entire space rapidly.

**Scientific Basis:** Particles possess internal *kinetic energy*. As the temperature rises, the kinetic energy increases, causing particles to move faster and mix quickly (Diffusion).

#### Characteristic 4: Particles of Matter Attract Each Other

**Real-World Evidence:** Attempting to break an iron nail requires immense mechanical force, whereas snapping a piece of school chalk is incredibly easy.

**Scientific Basis:** Intermolecular forces of attraction bind particles together. The strength of this attractive force varies from substance to substance, being highest in solids like iron and weaker in chalk.

### 3. Comparative Study of States of Matter

Matter primarily manifests in three distinct physical states based on particle arrangement: Solid, Liquid, and Gas.

[Image of arrangement of particles in solid, liquid and gas]

Property	Solid State	Liquid State	Gaseous State
Shape & Volume	Fixed shape; fixed volume.	No fixed shape; fixed volume.	No fixed shape; no fixed volume.
Compressibility	Negligible / Incompressible.	Low compressibility.	Highly compressible.
Density	High density.	Moderate density.	Very low density.
Particle Packing	Tightly packed in a rigid grid.	Less closely packed; can slide.	Far apart; random free motion.
Intermolecular Force	Extremely strong.	Moderate strength.	Negligible / Very weak.
Common Examples	Wood, Iron, Ice, Stone.	Water, Milk, Cooking Oil.	Oxygen, Nitrogen, Steam, CNG.

## 4. Interconversion of States of Matter

A substance can transition from one physical state to another by varying either external temperature or atmospheric pressure conditions.

[Image of phase transition diagram of matter showing melting, vaporization, condensation, freezing, sublimation and deposition]

### Key Phase Transition Processes

- **Melting (Fusion):** The conversion of a solid phase into a liquid phase. The specific temperature at which a solid melts at atmospheric pressure is called its **Melting Point**. (Melting point of pure ice =  $0^{\circ}\text{C}$  or  $273.15\text{ K}$ ).
- **Freezing (Solidification):** The conversion of a liquid phase into a solid phase. (Freezing point of water =  $0^{\circ}\text{C}$ ).
- **Vaporisation:** The conversion of a liquid phase into a gaseous phase. The temperature at which a liquid dynamically boils at atmospheric pressure is its **Boiling Point**. (Boiling point of pure water =  $100^{\circ}\text{C}$  or  $373.15\text{ K}$ ).
- **Condensation:** The conversion of a gaseous phase back into a liquid phase (e.g., steam hitting a cold plate to form water droplets).
- **Sublimation:** The direct conversion of a solid into a gas without entering the intermediate liquid state. Common examples include Camphor, Naphthalene balls, and Dry Ice (solid carbon dioxide).

### The Phenomenon of Latent Heat

**Latent Heat of Fusion:** The exact quantity of heat energy required to completely convert  $1\text{ kg}$  of a solid into its liquid state at its melting point, under standard atmospheric pressure, without causing any change in temperature.

**Latent Heat of Vaporisation:** The quantity of heat energy required to convert  $1\text{ kg}$  of a liquid substance completely into its gaseous state at its boiling point, without changing the temperature. Steam at  $100^{\circ}\text{C}$  contains more energy than water at the same temperature due to this absorbed latent heat.

### Thermodynamic Effects & Pressure Variables

- **Increasing Temperature:** Supplies kinetic energy to particles, causing them to vibrate vigorously, overcome intermolecular forces, and change state.
- **Applying Pressure:** Compresses the large spaces between gas particles. When combined with cooling, high pressure liquefies gases easily. This principle is used to store Liquefied Petroleum Gas (LPG) and Compressed Natural Gas (CNG).

## 5. Evaporation vs. Boiling

**Evaporation** is a spontaneous surface phenomenon where a liquid transitions into vapor at *any temperature below its standard boiling point* (e.g., wet clothes drying on a line).

## Critical Factors Regulating Evaporation Rate

### 1. Surface Area Exposure:

Rate increases with greater surface area. Spreading wet clothes out accelerates drying.

### 2. Thermal Variations:

Higher temperatures supply kinetic energy, accelerating the rate of evaporation.

### 3. Atmospheric Humidity:

High ambient water vapor content slows down evaporation, which is why clothes dry slowly in the monsoon.

### 4. Ambient Wind Speed:

Stronger winds carry water vapor particles away instantly, increasing the rate of evaporation.

## The Cooling Effect of Evaporation

During evaporation, high-energy particles escape from the liquid's surface. To make up for this energy loss, the remaining liquid absorbs heat from its immediate surroundings, causing the surrounding temperature to drop.

- **Sweating:** Perspiration absorbs latent heat from our skin as it evaporates, cooling the body.
- **Acetone / Nail Polish Remover:** Evaporates rapidly when applied to the palm, absorbing energy and leaving a cold sensation.
- **Earthen Pots (Matkas):** Water seeps through porous clay walls and evaporates, cooling the water stored inside.

## 6. Temperature Scales & Unit Conversion

Kelvin ( $\text{K}$ ) is the standard SI unit of temperature. Conversions can be calculated using these simple formulas:

$$\text{Celsius to Kelvin: } \text{K} = ^\circ\text{C} + 273$$

$$\text{Kelvin to Celsius: } ^\circ\text{C} = \text{K} - 273$$

## 7. Comprehensive Quick Revision Summary

**Chapter Synopsis:** Matter consists of tiny particles that are constantly moving, have spaces between them, and attract each other. It exists as rigid solids, fluid liquids, or highly compressible gases. State changes are driven by temperature and pressure adjustments, involving latent heat. Evaporation is a surface-level cooling process distinct from bulk boiling.

### Core Keywords for High-Scoring Answers:

Particulate Nature

Kinetic Energy

Diffusion

Latent Heat of Fusion

Sublimation

Surface Phenomenon

Dry Ice