# Chapter – 1 Matter in Our Surroundings

## 1. Introduction to Matter

- Everything in the universe is made up of matter.
- Matter is anything that has **mass and occupies space**.
- Examples: Water, air, table, chair, plants, animals, etc.

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## 2. Physical Nature of Matter

### 2.1 Matter is Made Up of Particles

- All matter is composed of tiny, discrete particles.
- These particles are too small to be seen with the naked eye.
- **Evidence of particle nature of matter**:
    - Dissolving sugar or salt in water: The volume of water remains almost the same because the sugar particles adjust in the empty spaces between water molecules.

### 2.2 Particles of Matter Have Space Between Them

- When substances dissolve, their particles fill the gaps between the particles of the solvent.
- Example: When sugar is added to water, it disappears but does not overflow.

### 2.3 Particles of Matter are Continuously Moving

- Particles of matter are always in motion, exhibiting **Brownian motion**.
- **Evidence**:
    - **Diffusion**: The spreading of one substance into another.
        - Example: The smell of perfume spreading in a room.
        - The rate of diffusion is **faster in gases** than in liquids and solids due to larger intermolecular spaces.

### 2.4 Particles of Matter Attract Each Other

- The force of attraction between particles holds them together.
- The strength of this force varies between different types of matter:
    - **Strongest in solids** (iron, diamond).
    - **Weaker in liquids** (water, milk).
    - **Weakest in gases** (oxygen, nitrogen).

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# 3. States of Matter

Matter exists in **three primary states**:

1. **Solid**
2. **Liquid**
3. **Gas**

### 3.1 Properties of Solids

- **Definite shape and volume**: Solids maintain their shape unless force is applied.
- **Incompressibility**: Cannot be compressed due to tightly packed particles.
- **High density**: Solids are usually denser than liquids and gases.
- **Negligible diffusion**: Particles do not mix easily.
- **Strong intermolecular forces**: Particles are held tightly together.
- **Example**: Ice, wood, iron, stone.

### 3.2 Properties of Liquids

- **No fixed shape but fixed volume**: Liquids take the shape of the container.
- **More compressible than solids but less than gases**.
- **Lower density than solids** but higher than gases.
- **Moderate intermolecular forces** (weaker than solids but stronger than gases).
- **Can flow and diffuse**: Liquid particles move freely.
- **Example**: Water, milk, oil.

### 3.3 Properties of Gases

- **Neither fixed shape nor fixed volume**: They expand to fill the entire container.
- **Highly compressible**: Gases can be compressed into cylinders.
- **Lowest density** compared to solids and liquids.
- **Weak intermolecular forces**.
- **High diffusion rate**: Gas particles move freely.
- **Example**: Oxygen, carbon dioxide, nitrogen.

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# 4. Effect of Change of Temperature on Matter

- **Temperature affects the state of matter** by increasing or decreasing kinetic energy.

### 4.1 Melting (Fusion)

- The process by which a **solid changes into a liquid** upon heating.
- **Melting Point**: The temperature at which a solid turns into a liquid.

- Example: Ice melts at **0°C**.

### 4.2 Boiling (Vaporization)

- The process by which a **liquid changes into a gas** upon heating.
- **Boiling Point**: The temperature at which a liquid turns into a gas.
- Example: Water boils at **100°C**.

### 4.3 Evaporation

- The process of **conversion of liquid into gas at any temperature below its boiling point**.
- Occurs at the surface of the liquid.
- **Factors Affecting Evaporation**:
  - **Surface area**: More surface area = faster evaporation.
  - **Temperature**: Higher temperature = faster evaporation.
  - **Humidity**: More humidity = slower evaporation.
  - **Wind speed**: Faster wind = faster evaporation.
  - **Example**: Sweat evaporates from our body, cooling it down.

### 4.4 Condensation

- The process of **conversion of gas into liquid** on cooling.
- Example: Water droplets on a cold bottle from moisture in the air.

### 4.5 Sublimation

- Direct conversion of **solid to gas without becoming liquid**.
- Example: Camphor, dry ice (solid $CO_2$).

### 4.6 Freezing (Solidification)

- The process of **conversion of liquid into solid** by cooling.
- Example: Water freezes at **0°C** to form ice.

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## 5. Effect of Pressure on Matter

- **Increasing pressure can change the state of matter**:
  - **Gases can be liquefied by increasing pressure**.
  - Example: LPG cylinders contain liquefied petroleum gas (LPG).
- Solid carbon dioxide (dry ice) converts directly into gas under normal atmospheric pressure.

## 6. Latent Heat

- **Latent Heat of Fusion**: Heat energy required to change **1 kg of solid into liquid at its melting point**.
- **Latent Heat of Vaporization**: Heat energy required to change **1 kg of liquid into gas at its boiling point**.

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## 7. Evaporation and Cooling

- Evaporation causes cooling because particles absorb energy from the surroundings to convert into vapor.
- Examples:
  - Water cools after evaporation.
  - Earthen pots keep water cool due to evaporation.
  - Sweat cools our body.

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## 8. Plasma and Bose-Einstein Condensate (BEC) – Additional States of Matter

1. **Plasma**:
   - Found in stars, lightning, and neon lights.
   - Consists of highly charged particles.
2. **Bose-Einstein Condensate (BEC)**:
   - Discovered by Satyendra Nath Bose and Albert Einstein.
   - Formed when matter is cooled to near absolute zero.
   - Particles behave as a single unit.

## 9. Vaporization:

**Vaporization** is the process by which a liquid changes into a gas (or vapor) when heat is supplied. It occurs in two ways:

1. **Evaporation** – Slow vaporization at the surface of a liquid (occurs at all temperatures).
2. **Boiling** – Rapid vaporization throughout the liquid at a fixed temperature (boiling point).

### Key Differences Between Evaporation and Boiling

| Feature | Evaporation | Boiling |
|---|---|---|
| **Occurrence** | Only at the surface | Throughout the liquid |
| **Temperature** | Occurs at any temperature | Occurs only at boiling point |
| **Speed** | Slow process | Fast process |
| **Bubble Formation** | No bubbles | Bubbles form inside the liquid |
| **Energy Requirement** | Less energy required | More energy required |

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# Factors Affecting Vaporization

## 1. Temperature

- Higher temperature increases the kinetic energy of molecules, leading to faster vaporization.
- **Boiling Point**: The temperature at which a liquid turns into vapor rapidly.
    - Example: Water boils at **100°C** at 1 atm pressure.

## 2. Surface Area

- A larger surface area exposes more liquid molecules to the air, increasing vaporization.
    - Example: A wet cloth dries faster when spread out than when folded.



## 3. Humidity

- **Humidity** is the amount of water vapor present in the air.
    - **High humidity** slows down evaporation (air is already saturated with water vapor).
    - **Low humidity** speeds up evaporation (air can absorb more vapor).

## 4. Wind Speed

- Moving air (wind) carries away water vapor, maintaining a lower vapor pressure near the liquid surface.
    - Example: Clothes dry faster on a windy day.

## 5. Nature of the Liquid

- **Volatile liquids** (e.g., alcohol, acetone) evaporate faster due to weak intermolecular forces.
- **Non-volatile liquids** (e.g., oil, honey) evaporate slowly due to strong intermolecular forces.

### 6. Pressure

- **Lower atmospheric pressure** reduces the boiling point, making vaporization easier.
    - Example: At high altitudes, water boils below **100°C** due to lower air pressure.

# 10. What is Evaporation?

Evaporation is the process by which a liquid changes into a gas (vapor) **at its surface** and **below its boiling point**. It is a **slow, surface-level** phenomenon that occurs at all temperatures.

### Key Features of Evaporation:

- Occurs **only at the surface** of a liquid.
- Happens **at all temperatures** (not just boiling point).
- A **cooling process** (absorbs heat from surroundings).
- Example: Drying of clothes, evaporation of sweat.



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# Factors Affecting Evaporation

### 1. Temperature

- **Higher temperature → Faster evaporation**
    - Increased heat provides more kinetic energy to molecules, helping them escape as vapor.
    - Example: Water evaporates faster on a hot day than on a cold day.

### 2. Surface Area

- **Larger surface area → Faster evaporation**
    - More molecules are exposed to air, increasing the rate of escape.

- Example: A spilled liquid dries faster when spread out than when in a small container.

### 3. Humidity (Amount of Water Vapor in Air)

- **Low humidity → Faster evaporation**
  - Dry air absorbs more water vapor.
- **High humidity → Slower evaporation**
  - Air is already saturated with moisture, reducing evaporation rate.
  - Example: Clothes dry slowly on a humid day.

### 4. Wind Speed

- **Higher wind speed → Faster evaporation**
  - Wind removes water vapor near the surface, allowing more molecules to escape.
  - Example: Wet clothes dry faster in windy conditions.

### 5. Nature of the Liquid

- **Volatile liquids (e.g., alcohol, acetone) evaporate faster**
  - Weak intermolecular forces make escape easier.
- **Non-volatile liquids (e.g., oil, honey) evaporate slower**
  - Strong intermolecular forces hold molecules together.

### 6. Pressure

- **Lower pressure → Faster evaporation**
  - Reduced atmospheric pressure makes it easier for molecules to escape.
  - Example: Water evaporates faster at high altitudes (low pressure).



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# Cooling Effect of Evaporation

- Evaporation absorbs **latent heat** from the surroundings, causing cooling.
- **Examples:**
  - **Sweating cools the body** (water absorbs heat when evaporating).