



### 1) States of Matter

Matter can generally take 3 different forms: **solids**, **liquids** or **gases**.

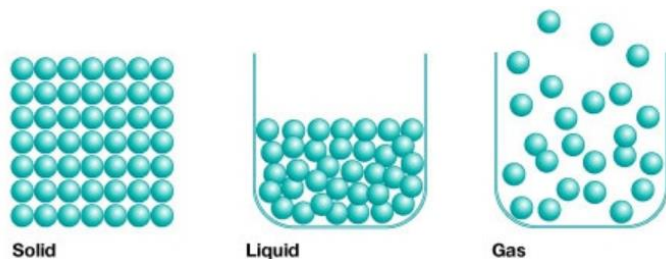
### 2) Properties of Solids, Liquids and Gases

A property of a substance is a characteristic that we can use to describe it.

- Δ Solids can not flow and have fixed shapes. They can not be compressed (squashed).
- Δ Liquids flow and take the shape of their container. They can **not** be compressed (squashed).
- Δ Gases flow and fill their container. They can be compressed (squashed).

### 3) Particle Theory

The particles that make up all objects are arranged differently for solids, liquids and gases. Their arrangement affects their properties. The particles also have different amounts of energy in each state.



- Solids – particles all touching in a regular pattern, particles vibrate on the spot but are not free to move.
- Liquids – particles touching but not in a regular arrangement and can move freely past each other.
- Gases – particles are randomly far apart and can move freely.

### 4) Density

Density is a measure of how tightly packed the particles are in a given volume. The equation to calculate the density of an object is:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

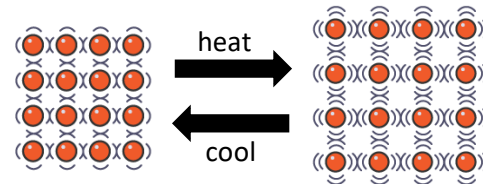
The units for density are  $\text{kg/m}^3$  or  $\text{g/cm}^3$ .

- To measure the **mass** of an object we use a digital **balance**.
- To measure the volume of a regular shaped solid we use a ruler and measure its length, width and height and then use the equation: **volume = length x width x height**

For irregular solids we can use **displacement of water** to measure the volume.

### 5) Expansion & Contraction

When solids, liquids and gases are **heated** they **expand** (get bigger). This is because the particles **gain more energy** from the heat so **move more quickly**. As they move more quickly the particles **spread out more** so the object expands.



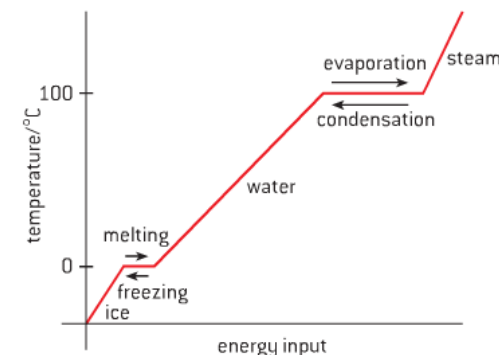
Likewise when objects cool down the particles have less energy and so move more slowly so spaces between the particles get smaller. This is called contraction.

### 6) Changes of State

Melting = solid to liquid	Freezing = liquid to solid
Evaporation = liquid to gas	Condensation = gas to liquid
Sublimation = solid to gas	Deposition = gas to solid

### 7) Changes of State

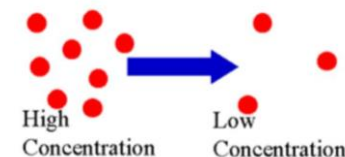
When we increase the energy of a substance and measure its temperature with a thermometer the graph looks like this:



The horizontal parts are caused by energy being needed to break bonds and change state .i.e. move from solid to liquid to gas.

### 8) Diffusion

Diffusion is the **movement of particles** from an area of **high concentration** to an area of **lower concentration**. It happens in fluids (liquids and gases).



Think of concentration a bit like density (the number of particles in a given volume).

Diffusion is caused by the energy of the particles moving and it happens faster in gases than it is in liquids. Increasing temperature can also speed up the rate of diffusion.

### Key Words

**Particles, Energy, Density, Diffusion, Concentration, Melting, Freezing, Boiling, Condensation, Evaporation, Mass, Volume**

## Phase changes of matter

