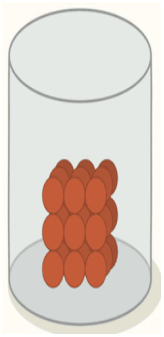
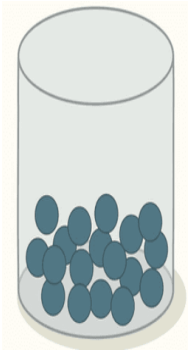
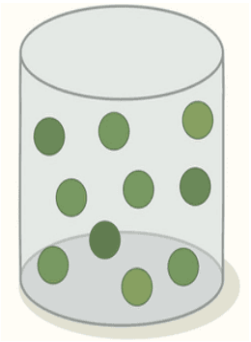
States of Matter

Solids, Liquids and Gases

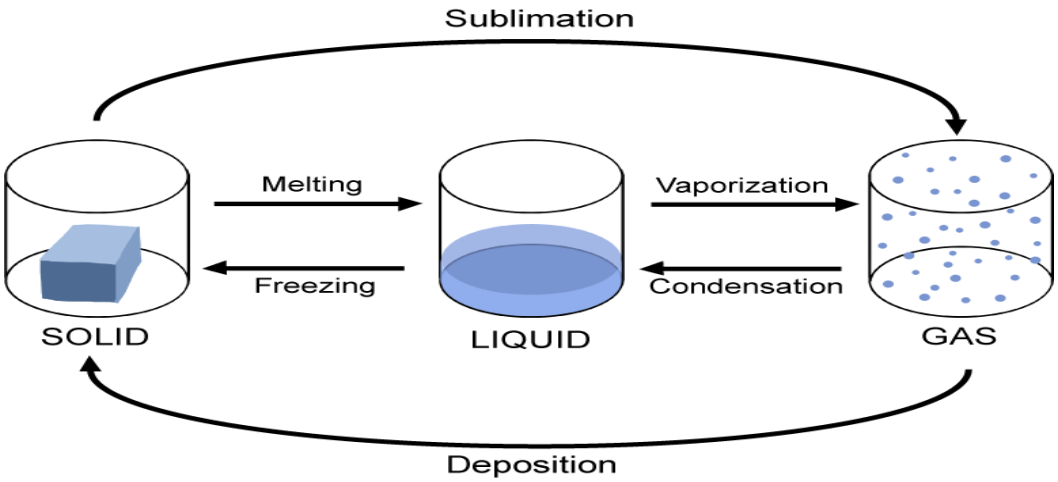
- States of Matter are the different forms in which matter can exist
- The three states of matter are **Solid, Liquids, and Gases**

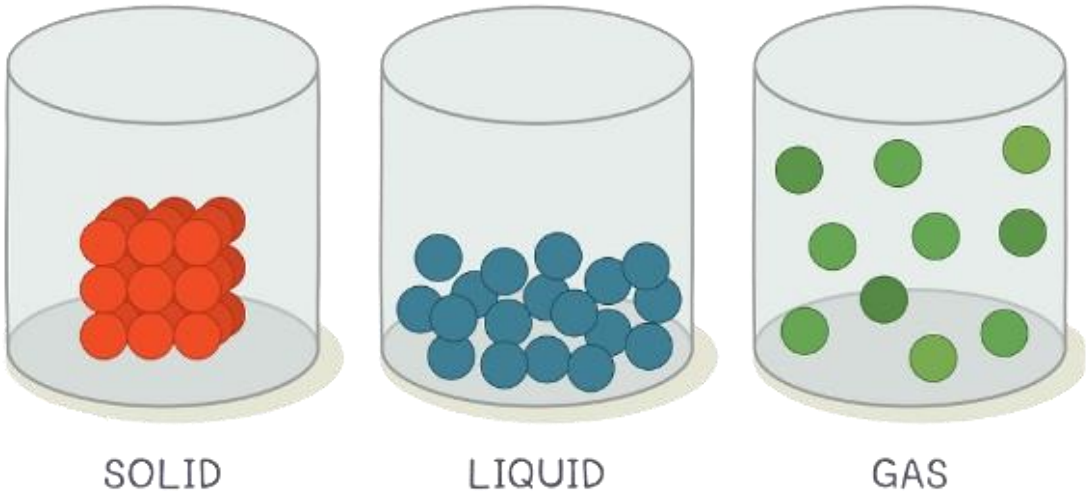
Properties of Solid, Liquid and Gases

	Solids	**Liquids**	**Gases**
Shape	have a definite shape	take the shape of their container	take the shape of their container
Density	high	medium	low
Volume	have a fixed volume	have a fixed volume	no fixed volume
Particle Motion	particles can vibrate about their fixed positions	particles can move past one another	particles are mobile and move randomly
Particle Arrangement	particles are arranged regularly in a lattice	particles are randomly arranged	particles are randomly arranged

	Solids	Liquids	Gases
Diagram			

Interactive 3D diagram: Phase Transitions





Changes of States

Boiling and Evaporation:

Boiling and Evaporation are both **endothermic processes**:

- Boiling and evaporation are processes that involve the conversion of a liquid into a gas.
- Both processes allow **molecules to move further apart from each other**.

Boiling	Evaporation
happens at a set temperature called the **boiling point**	occurs at any temperature below the boiling point and above the freezing point (liquid)
occurs throughout the liquid	only occurs at the surface
relatively faster process	a slow process

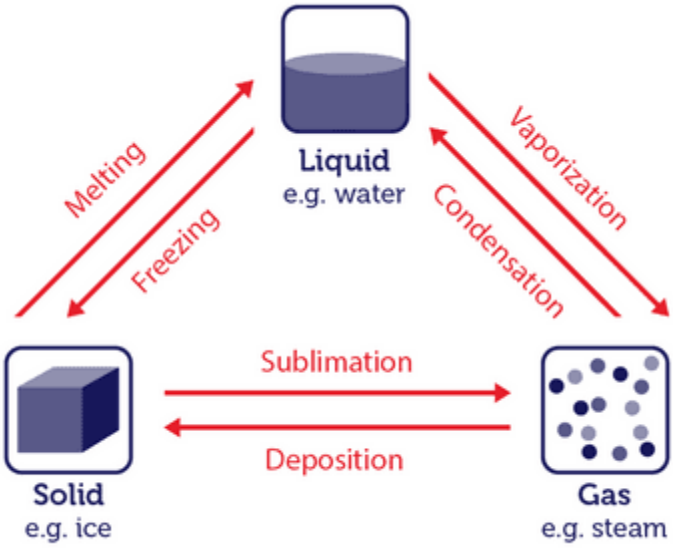
Condensation

Condensation is the process by which a gas converts into a liquid. It happens at the same temperature as the boiling point.

- As temperature decreases, the **energy of particles will decrease**, making them move more slowly.
- Condensation and Freezing are both **energy-given-out reactions**.

Freezing, Melting and Sublimation

1. Melting is the process in which a solid convert to a liquid. It happens at a set temperature called the **melting point**.
2. Freezing is the process in which a liquid converts to a solid. It happens at the same temperature as the freezing point.
3. Sublimation occurs when a solid has enough energy to convert into a gas or gas converted into a solid.



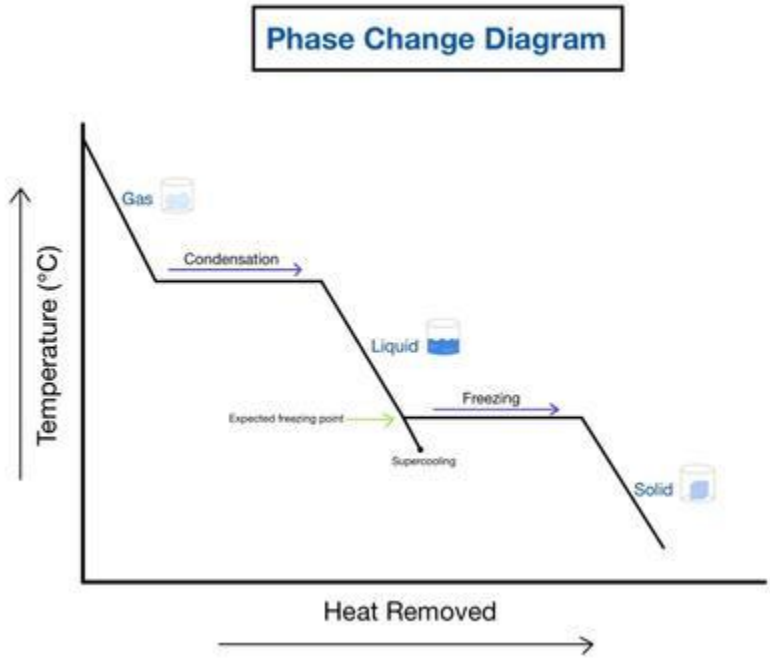
Cooling and Heating Curves

Cooling Curves

1. On cooling, the particles of a gas move slower and slower and the gas contracts
2. The particles are now closer together, and inter-molecular bonds start to form between them once the condensation point is reached
3. The temperature of the substance stops falling; the energy released by bond formation cancels out the energy lost due to cooling

4. Once all the gas has turned into liquid, the temperature starts to fall again, and the liquid begins to contract until the freezing point is reached
5. At the freezing point, inter-molecular bonds between the liquid molecules start to develop to form a solid
6. At the freezing point, the temperature remains constant until all of the liquid has solidified since the energy released due to bond formation cancels out the energy lost due to cooling

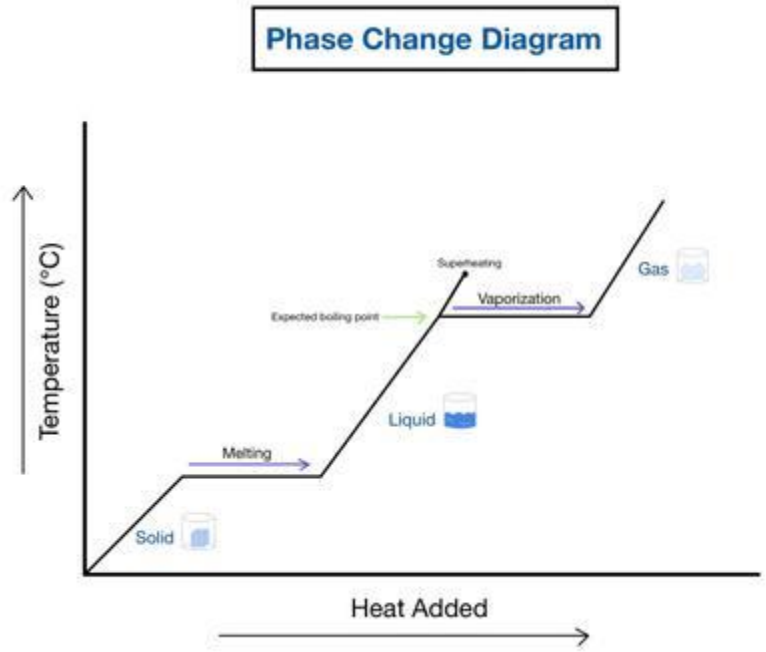
The following curve is obtained if this phenomenon is plotted - the cooling curve:



Heating Curves

1. On heating, the particles of a solid start to vibrate faster and faster in their mean positions, and the solid begins to expand
2. Once the melting point is reached, the intermolecular bonds between the particles begin to break.
3. The temperature of the substance at this point remains constant until all the solid has turned into a liquid because the energy received by the system is cancelled out by the energy used to break intermolecular bonds
4. Once all the solid has turned to liquid, the temperature starts to rise again, and the liquid begins to expand until the boiling point is reached
5. At the boiling point, the intermolecular bonds between the liquid molecules start to break down to form a gas
6. At the boiling point, the temperature of the substance remains constant until all of the liquid has vaporised since the energy absorbed by the substance is cancelled by the energy used for the breakdown of intermolecular bonds

The following curve is obtained if this phenomenon is plotted - the heating curve:



Diffusion

Diffusion: the net movement of particles from a region of higher concentration to a region of lower concentration as a result of their random movement until equilibrium is reached.

- The rate of diffusion is most rapid in gases > liquids > solids.
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Effect of Relative Molecular Mass in Diffusion

- The rate at which gases diffuse differs and depends on the gas's molecular' mass.
- At the same temperature, molecules with a lower mass move faster on average than those with a higher mass.
- Rate of Diffusion is inversely proportional to Molecular Mass
- Rate of Diffusion **x** 1 / Molecular Mass

Pressure and Temperature on Gas

Gases are compressible. By changing the pressure acting on them, their volume may be influenced.

1. An increase in external pressure produces a contraction (**decrease**) in volume. The gas is said to be **compressed**.
2. A fall in external pressure produces an expansion (**increase**) in volume. The gas is said to be decompressed.

The volume of gases may also be influenced by temperature. The temperature of a gas affects its internal pressure and, thereby, its volume.

1. When temperature increases, the gas molecules have **increased kinetic energy** and hit the walls of their container more often and with greater force. This causes an increase in internal pressure and an increase in volume.
2. When the temperature decreases, the gas molecules have decreased kinetic energy and hit the walls of their container less often and with attenuated force. This causes a decrease in internal pressure and a decrease in volume.