The Thomas Alleyne Academy

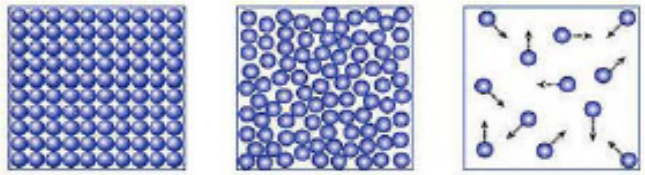
Knowledge Organiser - Particles

Science Department

KPI 7CP 1: Describe the arrangement of particles in a solid, liquid and gas, and link this to their properties

Particle Theory

All matter is made up of particles. Particles are found in all 3 states of matter. Particles in the 3 states behave differently.



Solid Liquid Gas

In **solids**, particles are arranged in a **regular pattern** and they can only **vibrate** in a fixed position. Particles in solids are not free to move.
In **liquids**, particles can **slide pass** each other. They are **arranged randomly.**
In **gases**, particles carry a lot of energy and they **move in all directions** in a high speed. Particles are **far apart** and are **arranged randomly.**

Diffusion and Factors Affecting Diffusion

Diffusion is the **movement of particles from a higher concentration to a lower concentration. Diffusion will stop when particles spread themselves evenly.** Diffusion occurs in liquids and gases but not in solids, because particles in a solid are not free to move.

Diffusion

There are 2 **factors** affecting the rate of diffusion:

1. **Temperature:** When temperature increases, particles gain more energy. They can then move and spread out at a higher rate.
2. **Concentration:** When concentration increases, the rate of diffusion increases.

Key Terms	Definitions
State of matter	Matter is divided into three states: solid, liquid, and gas.
Melting	Change of state from solid to liquid.
Freezing	Change of state from liquid to solid
Evaporation	Change of state from liquid to gas.
Condensation	Change of state from gas to liquid.
Diffusion	Particles spread from a region of higher concentration to a region of lower concentration.
Rate	How fast an event, e.g. diffusion, is happening.
Concentration	The number of particles in a known volume.
Particles	All matter is made up of tiny particles.
Pressure	Pressure is formed when particles collide with the walls of containers.

State	Properties
SOLID	Fixed shape, cannot flow, cannot be compressed (squashed) ***Particles can vibrate in a fixed position but cannot more past each other. Particles are close together.***
LIQUID	Can flow, will take the shape of a container, cannot be compressed (squashed) ***Particles are close together but are able to move past each other.***
GAS	Flow, completely fill any space that they occupy, can be compressed squashed. ***Particles can move quickly in all directions, are far apart and have space to move into.***

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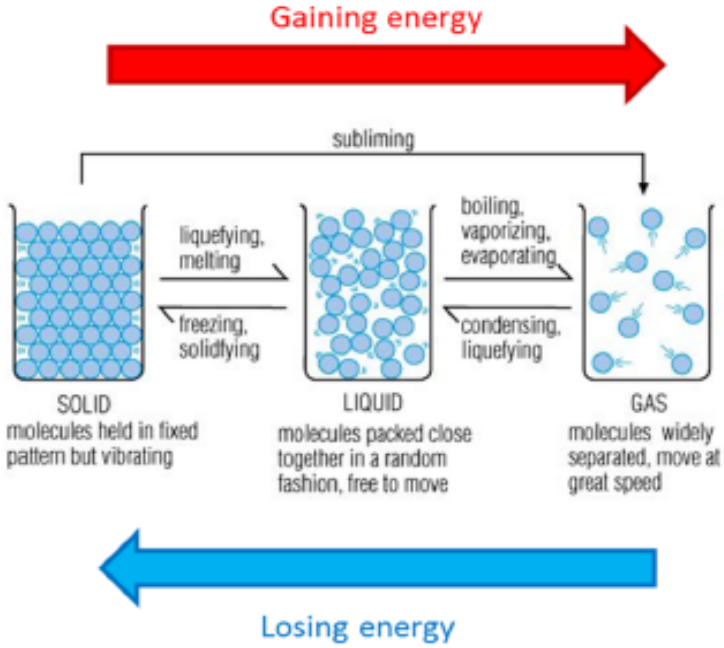
KPI 7CP 2: Explain changes of state in terms of the particle model

Change of State

Changes of state take place when the particles gain or lose energy. When energy is applied, particles gain energy and move further apart. When energy is lost, particles become closer to each other and arrange themselves more regularly.

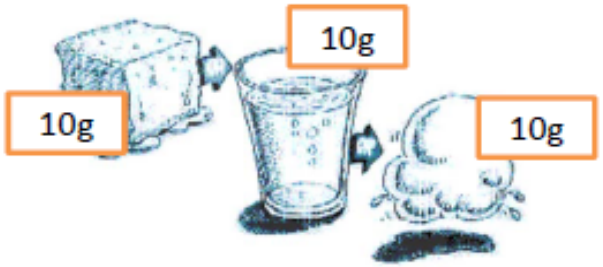
As particles gain more energy they spread out more and their movement becomes more random.

When substances change state all of the energy supplied to the substance goes towards breaking the bonds between the particles and not into increasing the temperature of the substance.



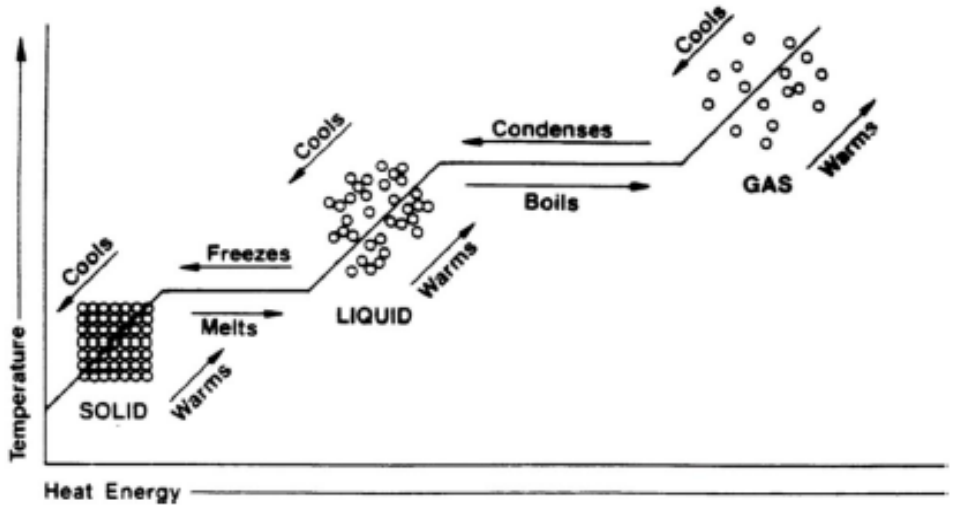
Conservation of Mass

Mass stays the same before and after a change of state. For example, 10g of ice melts into 10g of water, and 10g of water evaporates into 10g of water vapour. The same applies to other substances.



Interpreting the Energy-Temperature Graph

During the change of state, **the temperature will stay the same until the change of state has been completed**, i.e. all liquid has turned into gas, all liquid has frozen into solid, etc.



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KPI 7CP 3: Classify substances as pure and impure, and describe techniques to separate mixtures

Pure and Impure Substance

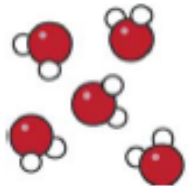
Pure Substances

If you could see the particles in pure water, you would only see water particles. There would be no other particles. Examples of pure substances include gold, oxygen and pure water.

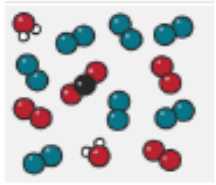
Impure Substances

Impure materials may be mixtures of elements, mixtures of compounds, or mixtures of elements and compounds. For example, even the most pure water will contain dissolved gases from the air. Impurities in a substance will affect its properties. For example, they may change its boiling point.

Pure Substances



Impure Substances



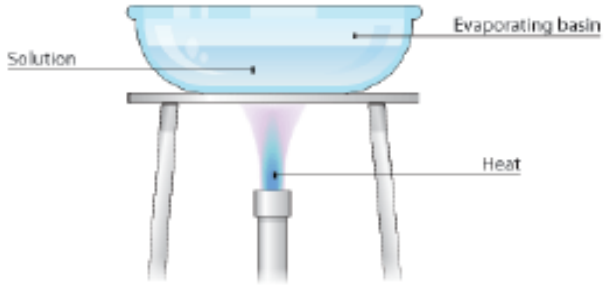
Mixtures

A mixture contains different substances that are not chemically joined to each other. For example, a packet of sweets may contain a mixture of different coloured sweets. The sweets are not joined to each other, so they can be picked out and put into separate piles.

Key Terms	Definitions
Pure	A material that is composed of only one type of particle.
Impure	A material that is composed of more than one type of particle.
Evaporation	A change of state involving a liquid changing to a gas
Distillation	A process for separating the parts of a liquid solution. The solvent is heated and the gas is collected and cooled.
Filtration	The act of pouring a mixture through a mesh, in attempts to separate the components of the mixture.
Mixture	A material made up of at least two different pure substances.
Chromatography	A technique used to separate mixtures of coloured compounds.

Evaporation

This is good for separating a soluble solid from a liquid (a soluble substance dissolves, to form a solution). For example copper sulphate crystals can be separated from copper sulphate solution using evaporation. Remember that it is the water that evaporates away, not the solution.



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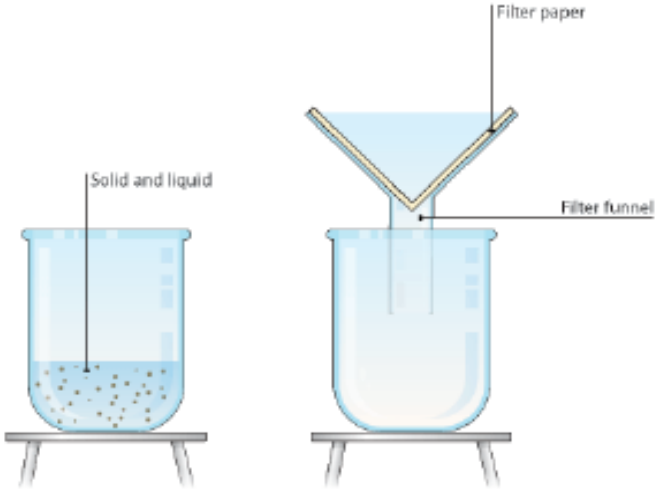
KPI 7CP 3: Classify substances as pure and impure, and describe techniques to separate mixtures

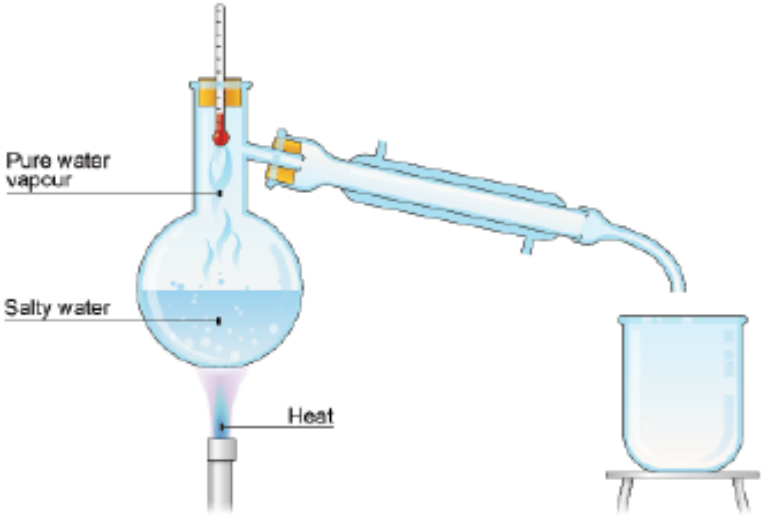
Filtration

This is good for separating an insoluble solid from a liquid. (An insoluble substance is one that does not dissolve). Sand, for example, can be separated from a mixture of sand and water using filtration. That's because sand does not dissolve in water.



Distillation

This is good for separating a liquid from a solution. For example, water can be separated from salty water by simple distillation. This method works because the water evaporates from the solution, but is then cooled and condensed into a separate container. The salt does not evaporate and so it stays behind. Distillation can also be used to separate two liquids that have different boiling points.



Chromatography

Simple chromatography is carried out on paper. A spot of the mixture is placed near the bottom of a piece of chromatography paper and the paper is then placed upright in a suitable solvent, e.g. water. As the solvent soaks up the paper, it carries the mixtures with it. Different components of the mixture will move at different rates. This separates the mixture out.