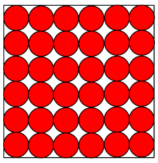
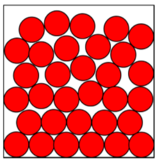
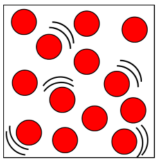
Particle Model of Matter

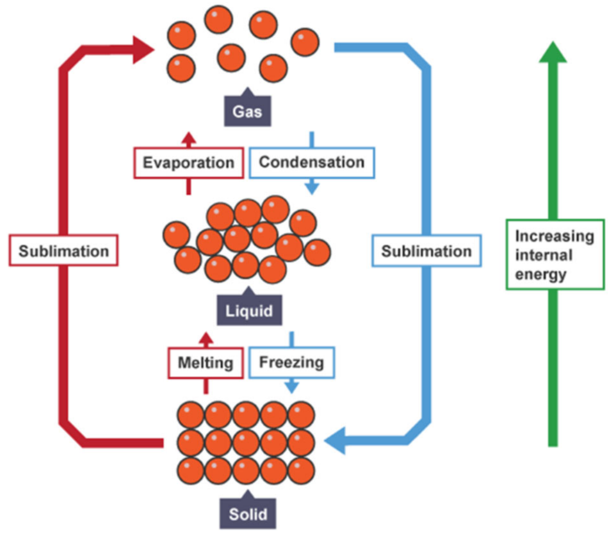
Internal energy

Internal energy is the sum of a particles **kinetic energy** and the **intermolecular forces** between the particles.

Solids, Liquids & Gases

State	Solid	Liquid	Gas
Diagram			
Arrangement of	Regular	Random	Random
Movement of	Vibrate about a	Flow around	Move quickly in
Closeness of	Very close	Close	Far apart

Changes of State



Materials change states due to a change in their **internal energy**.

When a substance is **heated** the **kinetic energy** of the particles **increases** and the **intermolecular bonds** between the particles **break**.

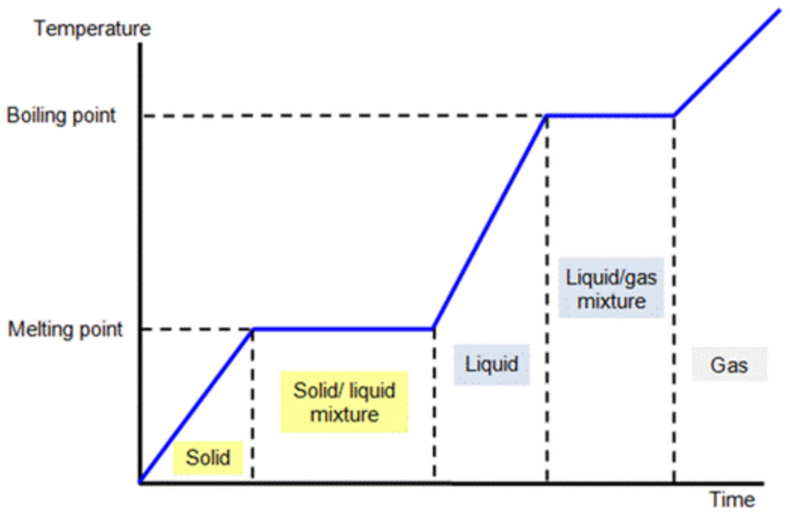
When a substance is **cooled** the **kinetic energy** of the particles **decrease** and the **intermolecular bonds** between the particles **form**.

Heat vs. Temperature

Heat is the **total energy** of an object due to the **kinetic energy** of its particles. Heat is measured in **Joules** (**J**).

Temperature measures the **average kinetic energy** of molecules in an object. Temperature is measured in **Degrees Celsius** (**°C**) or **Kelvin** (**K**).

Latent Heat



The graph above shows that the temperature of a substance does **not** change during **changes of states** instead remains constant. This is because of the energy going into the material is **overcoming** the intermolecular forces between the particles when the substance is **heated**, and is released when molecules **reform** due to the intermolecular forces when the substance is **cooled**,

Latent Heat is the amount of energy transferred to a substance when it changes state. There are two types of latent heat:

- **Latent Heat of Fusion**—solid to a liquid/liquid to a solid
- **Latent Heat of Vaporisation**—liquid to a gas/gas to a

Specific Latent Heat

The Specific Latent Heat of Fusion is the energy required to change 1 kg of a material from a solid to a liquid at constant temperature.

The Specific Latent Heat of Vaporisation is the energy required to change 1 kg of a material from a liquid to a gas at constant temperature.

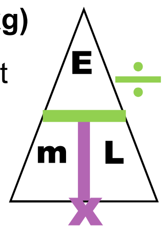
Both the Specific Heat of Fusion and Vaporisation are calculated using:

$$E = m \times L$$

E = energy measured in Joules **(J)**

m = mass measured in kilograms **(kg)**

L = latent heat of fusion **or** the latent heat of vaporisation measured in Joules per kilogram **(J/kg)**



Specific Heat Capacity

The specific heat capacity is the amount of energy required to raise the temperature of a 1 kg substance by 1 °C.

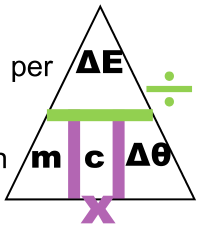
$$\Delta E = m \times c \times \Delta\theta$$

ΔE = change in energy measured in Joules (**J**)

m = mass measured in kilograms (**kg**)

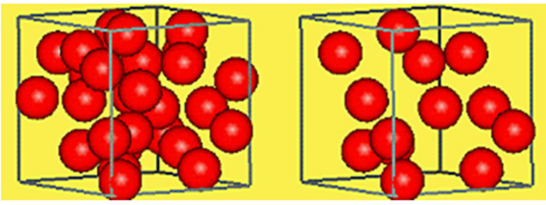
c = specific heat capacity measured in joules per kilogram degrees Celsius (**J / kg °C**)

Δθ = change in temperature measured in degrees Celsius (**°C**)



Density

Density is the amount of mass in a volume. It tells us how tightly particles are packed together.



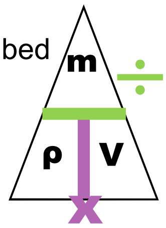
Density is calculate using:

$$\rho = \frac{m}{V}$$

ρ = density measured in kilograms per metre cubed (**kg/m^3**)

m = mass measured in kilograms (**kg**)

V = volume measured in metres cubed (**m^3**)



Particle Motion in Gases

The pressure of a gas results from collisions between the gas particles and the walls of the container. Each time a gas particle hits the wall, it exerts a force on the wall. The more particles that hit the walls, the higher the pressure.

As the **temperature increases**, the particles gain kinetic energy and begin to move faster. This makes them collide with the sides of the container with more force. If the increase in force is large enough, the container will expand in volume.