the particulate nature of matter

Brownian Motion

the random movement of microscopic particles in liquid or gas.

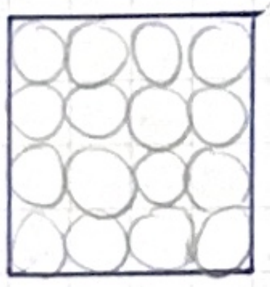
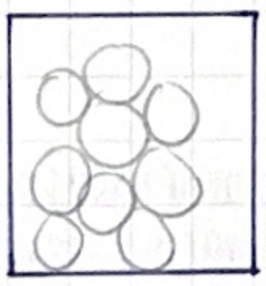
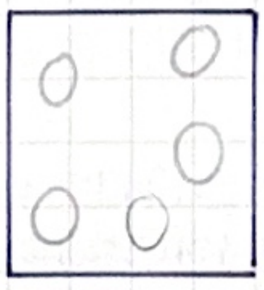
↓ proves that:

matter is made up of small discrete particles in constant and random movement.

↓

particles do not move in straight path but more randomly

particulate nature of matter

	solid	liquid	gas
Arrangement of particles	closely packed in an orderly arrangement	closely packed in a disorderly arrange-ment	far apart in a disorderly arrangem-ent
movement of particles	vibrate about their fixed positions	moves freely and slowly within the liquid body	moves freely at high speeds within the container
forces of attraction	very strong	strong	weak
diagram of models			

↓

- touching one another; not overlapping
- space among particles drawn must not be big enough to fit in another particle.

Physical properties

property	solid	liquid	gas
shape	has definite shape	no definite shape	no definite shape
volume	has definite volume	has definite volume	no definite volume
compressibility	cannot be compressed	cannot be compressed	can be compressed

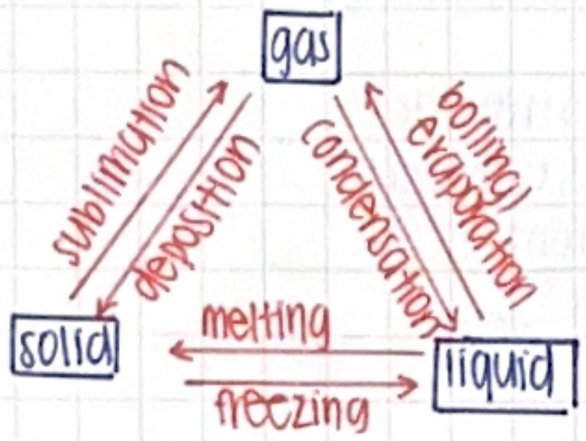
small van

shape movement volume arrangement

Expansion and Contraction

Expansion	Contraction
- Particles have an increased kinetic energy upon heating ↓ Thus, volume increases	- Particles decrease in kinetic energy upon cooling ↓ Thus, volume decreases
- Size of particles remains the same	- Size of particles remains the same

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$ mass - does not change; volume - changes



Melting

1. Kinetic energy of particles increases and particles vibrate faster about their fixed positions.
2. Particles gain enough energy to overcome the very strong force of attraction between them.

Diffusion

↳ the net random movement of particles from a region of higher concentration to a region of lower concentration.

Factors affecting rate of diffusion

factors	rate of diffusion
difference in concentration between two areas (↑)	Increase
temperature (↑)	Increase
diffusion distance (↑)	decreases
mass of particle (↑)	decreases

Thermal expansion and contraction

Temperature
- hotness or coldness of an object
- SI unit : Kelvin (K)

Heat
- amount of thermal energy in an object

As the amount of thermal energy increases, temperature increases.

Rate of expansion / contraction

solid < liquid < gas

- forces of attraction between particles in gas is weaker than forces of attraction between particles in liquid
- forces of attraction between gas particles are more easily overcome than in liquid particles
- particles in gas more further apart than particles in liquid.
- volume of gas increases more than volume of liquid / solid.

Bimetallic strips

brass
iron

consists of 2 different metals that expand at different rates upon heating

— when heated

Hot air balloon

1. When air in the hot air balloon is heated, its volume increases while mass remains unchanged
2. Density of air increases
3. Hotter and less dense air rises, causing the hot air balloon to float.

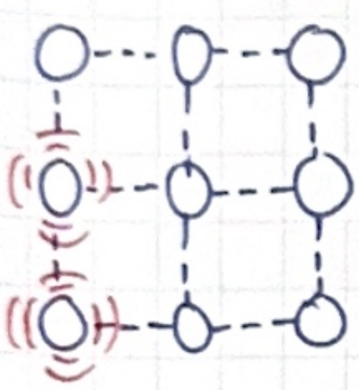
movement of heat

→ Heat flows from a region of higher temperature to a region of lower temperature, until there is thermal equilibrium

Conduction

- main mode of heat transfer for solid
- conduction is the process of heat energy transfer without any physical movement of material.

- Good COH transfer heat energy rapidly
- Insulators transfer heat energy slowly



1. All solids are made up of tiny particles that vibrate about their fixed positions
2. Heated particles will vibrate faster as they gain energy.
3. Particles collide with neighbouring particles, making them vibrate faster.

* KE is passed from hotter end to cooler end.

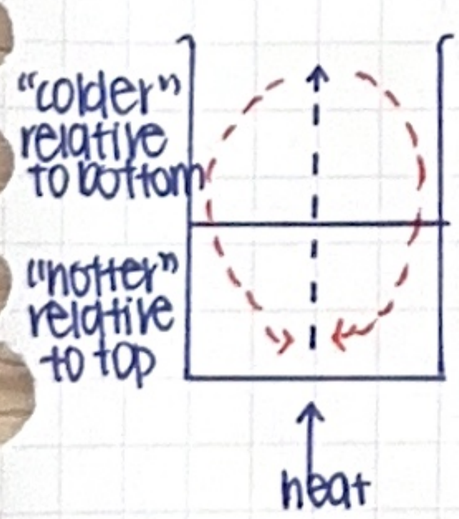
conduction is fastest in solids and slowest in gases.

gases → particles far apart → transfer of HE is slowest

convection

- main mode of heat transfer for fluids
- convection is the transfer of heat energy by movement of the fluids. (→ liquid or gas)

- Solids vibrate about their fixed positions and are not able to move around to transfer HE.



1. (↑) density decreases upon heating, causes heated water to rise
2. (↓) The surrounding water, being cooler, has a higher density and sinks
3. The process repeats and a convection current is set up.

Radiation

- main mode of heat transfer for vacuum
- radiation is the transmission of heat from one place to another by means of infra-red radiation.

↓

all objects can absorb infra-red radiation

↓

As absorption of infra-red radiation increases, temperature of object increases.

vice versa for emission

↓

The hotter the object, the greater the rate at which infra-red radiation is emitted.

Factors affecting radiation

1. colour and texture
   - good: dark colours; rough and dull surfaces
   - poor: light colours; smooth and shiny surfaces
2. surface temperature: higher temp compared to surroundings, higher rate of radiation
3. surface area: greater surface area (same mass and materials), higher rate of radiation