- Let the learners stand in different positions in the room.
- Observe what happens to the smell of the perfume.

Observations and results:

_____

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Conclusions:

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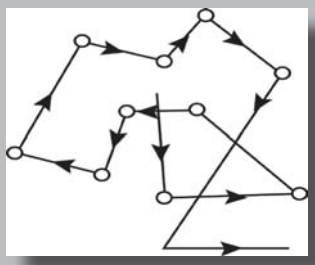
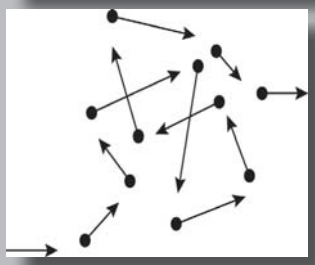
Statement:

Movement 1:
Small particles of the potassium permanganate collide with the water molecules and move through the liquid.

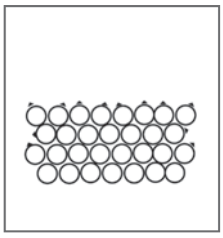
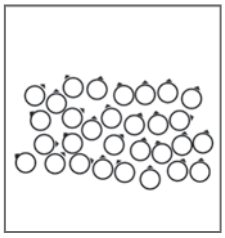
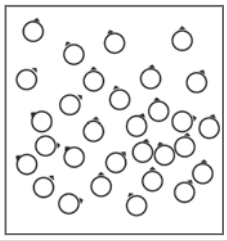


Movement 2:
The particles of the perfume collide with the air molecules.
Since the air molecules are far apart, the perfume moves freely and in straight lines.
The liquid particles are closer than the gas particles, therefore the movement is more restricted and the particles move less freely.



Diffusion is the movement of the particles of a substance in between the particles of a second substance from a high to a low concentration.

2.1.1 Various states (phases)

Solid	Liquid	Gas
		

Solid	Liquid	Gas
• Particles only vibrate. • Extremely small spaces between the particles • Very strong forces between the particles • Diffusion does not occur. • Cannot be compressed. • Retains its shape. • Particles arranged in a crystal lattice. • Has a specific melting point under standard conditions.	• Particles move randomly, but in restricted fashion. • Smaller spaces between the particles than in gases • Forces between the particles are weaker than in solids. • Diffusion occurs. • Collisions between the particles • Fills the base of the container. • Takes on the shape of the bottom of the container. • Liquids exert pressure in all directions. • Has a specific boiling point and freezing point under standard conditions.	• Particles move randomly and quickly. • Huge open spaces between the particles • Weak or negligible forces between particles • Diffusion occurs and it is faster than in liquids. • More intense collisions occur between particles than in liquids. • Is compressible. • Gas exerts pressure in all directions. • Has a specific condensation point under standard circumstances.

Freezing point: The temperature at which a liquid completely changes into a solid.

Melting point: The temperature at which a solid completely changes into a liquid.

Boiling point: The temperature of a liquid at which the vapour pressure is equal to the surrounding atmospheric pressure.

During a change of state (phase):
- The physical properties as well as the potential energy of the substance changes.
- The chemical composition remains the same.

The possible state changes are: melting, evaporation, condensation, freezing, crystallization and sublimation.

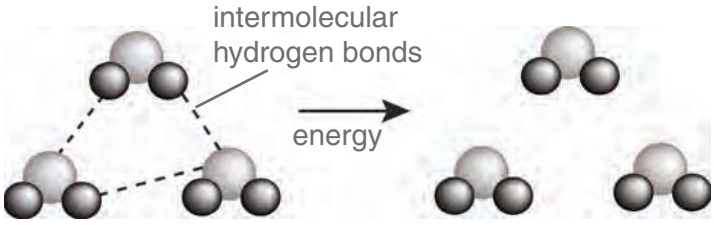
Quick facts

Sublimation: occurs when a solid changes directly into a gas.
Example: dry ice: $CO_2(s) \rightarrow CO_2(g)$

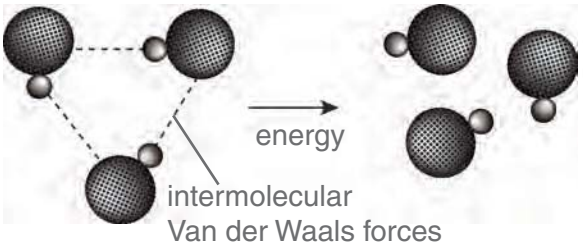
During a state change, the forces between the particles are weakened or overcome, when the motion of the particles becomes less organised. The forces between the particles are strengthened when the motion of the particles becomes more organised. In molecular substances, it is the weak intermolecular forces that are overcome or weakened first, so enabling the molecules to move further apart. The weakening or overcoming of the intermolecular forces requires relatively small amounts of energy.

Examples

H_2O:

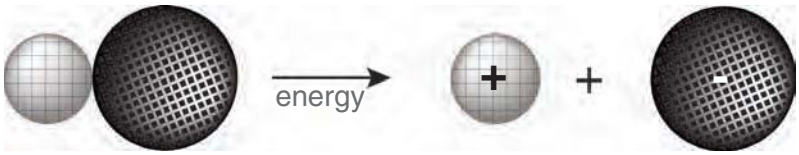


$HC\ell$:



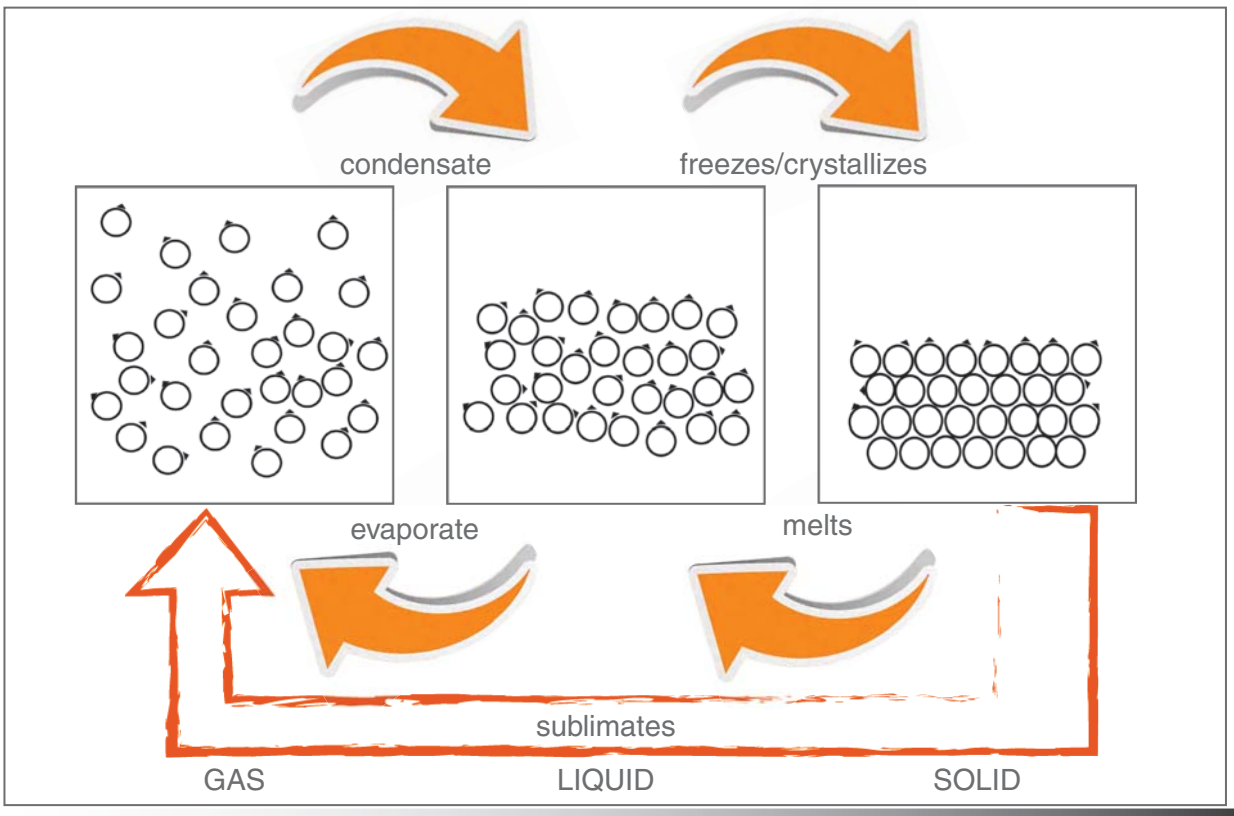
This weakening or breaking of the intermolecular forces requires relatively little energy.
No new chemical bonds are formed during a state change.
Most state changes can be reversed again. The particles move closer to each other and the forces concerned are strengthened again.

$NaC\ell$:



In ionic substances, it is the strong electrostatic forces between the ions that are broken or weakened. The ions are now free to move away from each other. It requires quite a lot more energy to break these strong electrostatic forces. The melting points of ionic substances are therefore very high.

The following flow diagram indicates the state changes.



Kinds of state changes

The state changes can be explained by looking at the type of state changes.

1. Condensation	2. Freezing
Just before condensation: • Particles move more slowly. • They are no longer far apart. • Collisions are less intense. Following the state change: • Spaces between the particles decrease. • Forces between the particles are stronger. • Particles move slower.	Just before freezing: • Particles move extremely slowly. • There are only vibrations. • Particles are very close together. Following the state change: • Extremely small spaces between the particles • Forces between the particles are stronger. • Arrangement is orderly and particles only vibrate.
4. Evaporation	**3. Melting**
Just before evaporation: • Particles move extremely fast. • Particles are far apart. • Severe collisions due to high velocity Following the state change: • Spaces between the particles are large. • Forces between the particles are weak. • Arrangement is random.	Just before melting: • Particles vibrate faster. • Particles are further apart. Following the state change: • Spaces between the particles increase. • Forces between the particles become weaker. • Arrangement is less orderly.

During a state change the:
- the particle size
- the particle shape
- the number of particles

} remain the same.

Quick facts

Movement of particles:
- Vibration is shivering.
- Rotation is turning around.
- Translation is changing places.

The total mass of the particles before a state change and the total mass of the particles after a state change, remains constant.

Change of energy during a state change

- During a state change, the speed of the particles does not change, therefore the kinetic energy of the particle does not change.
  Speed ∝ kinetic energy (E_K)
  Since the kinetic energy remains the same, **the temperature will also remain constant**. $E_K \propto T$ (the average kinetic energy of the particles is measured with a thermometer).
- During a state change, the additional energy is used to change the **potential energy of the particle** (potential energy cannot be measured).