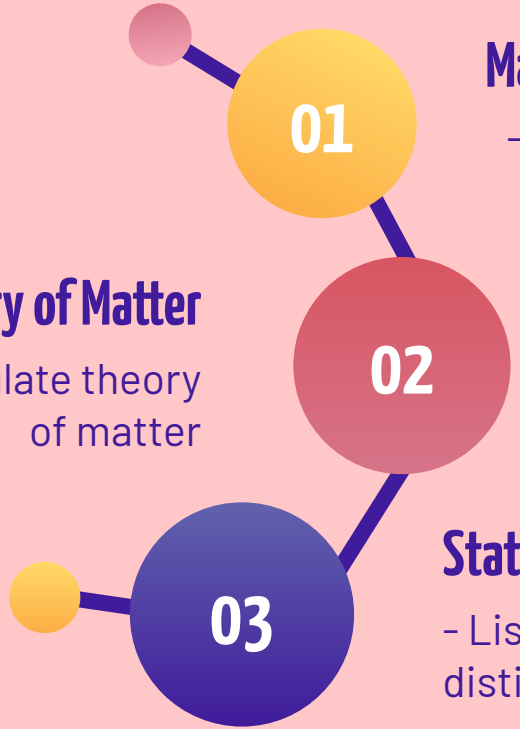
States of Matter

An Introduction to Chemistry

Presented by Mr Berkeley

Objectives



Matter

- Define matter and Chemistry

Particulate Theory of Matter

-Explain the particulate theory of matter

States of Matter

- List the states of matter, and distinguish among them

01

What is Chemistry?

And what does matter have to do with it?

What is Chemistry?

- **Chemistry** is the study of the structure and behaviour of matter.
- Everything around us is made up of **matter**.
- **Matter** is anything that has mass and takes up space.
- All matter is made up of **particles**

02 The Particulate Theory of Matter

What is matter made up of?

The Particulate Theory of Matter

- States that all matter is made up of **particles**.
- The particulate theory helps us to explain the physical properties of matter, as well as the differences between the states of matter

There are 4 main ideas behind the particulate theory of matter:

#1

All matter is composed of **particles**

#2

The particles are in constant motion, and **temperature** affects their speed of motion

#3

The particles have **empty spaces** between them

#4

The particles have **forces of attraction** between them

- **Temperature** is the property of matter which reflects the quantity of energy of motion of the component particles

- **Particulate**: relating to or in the form of tiny separate particles.

Types of Particles that make up matter

There are three different types of particles that make up matter:

Atoms

-Atoms are the smallest units of a **chemical element** which have all the characteristics of the element.

Molecules

-Molecules are groups of two or more atoms **bonded** together and which can exist on their own. Molecules may be made up of atoms of the same kind, e.g. hydrogen molecules, H, are made up of hydrogen atoms, H. Molecules may also be made up of atoms of different kinds, like H_2O, which is made up of 2 hydrogen atoms and 1 oxygen atom

Types of Particles that make up matter

There are three different types of particles that make up matter:

Ions

- Ions are electrically charged particles. Ions may be formed from a single atom, like a chlorine ion Cl^- or they may be formed from molecules like ammonium, NH_4^+

States of Matter

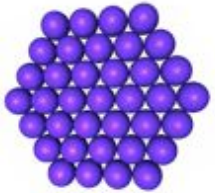
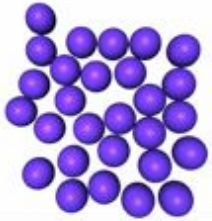
The forms by which matter can take

03

States of Matter

- There are 3 main states of matter found on Earth:
  - Solid
  - Liquid
  - Gas
- Other states include plasma, Bose-Einstein Condensates, Superconductors and more

Comparing the States of Matter

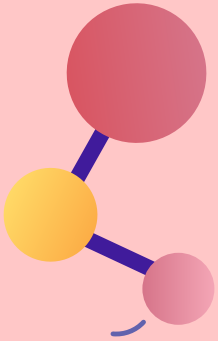
Solids	Liquids	Gases
		
• Strong attraction between the particles. • Particles are very close together and neatly arranged. • Particles vibrate in place.	• Moderate attraction between particles • Particles still very close together but not neatly arranged • Particles are able to slide passed each other.	• Very weak attraction between particles. • Particles are much further away from each other. • The particles move all around and bump into each other.
• Definite shape • Definite volume	• Indefinite shape • Definite volume	• Indefinite shape • Indefinite volume

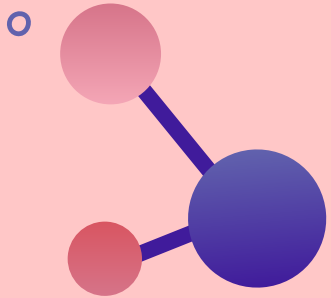
(serious this time)

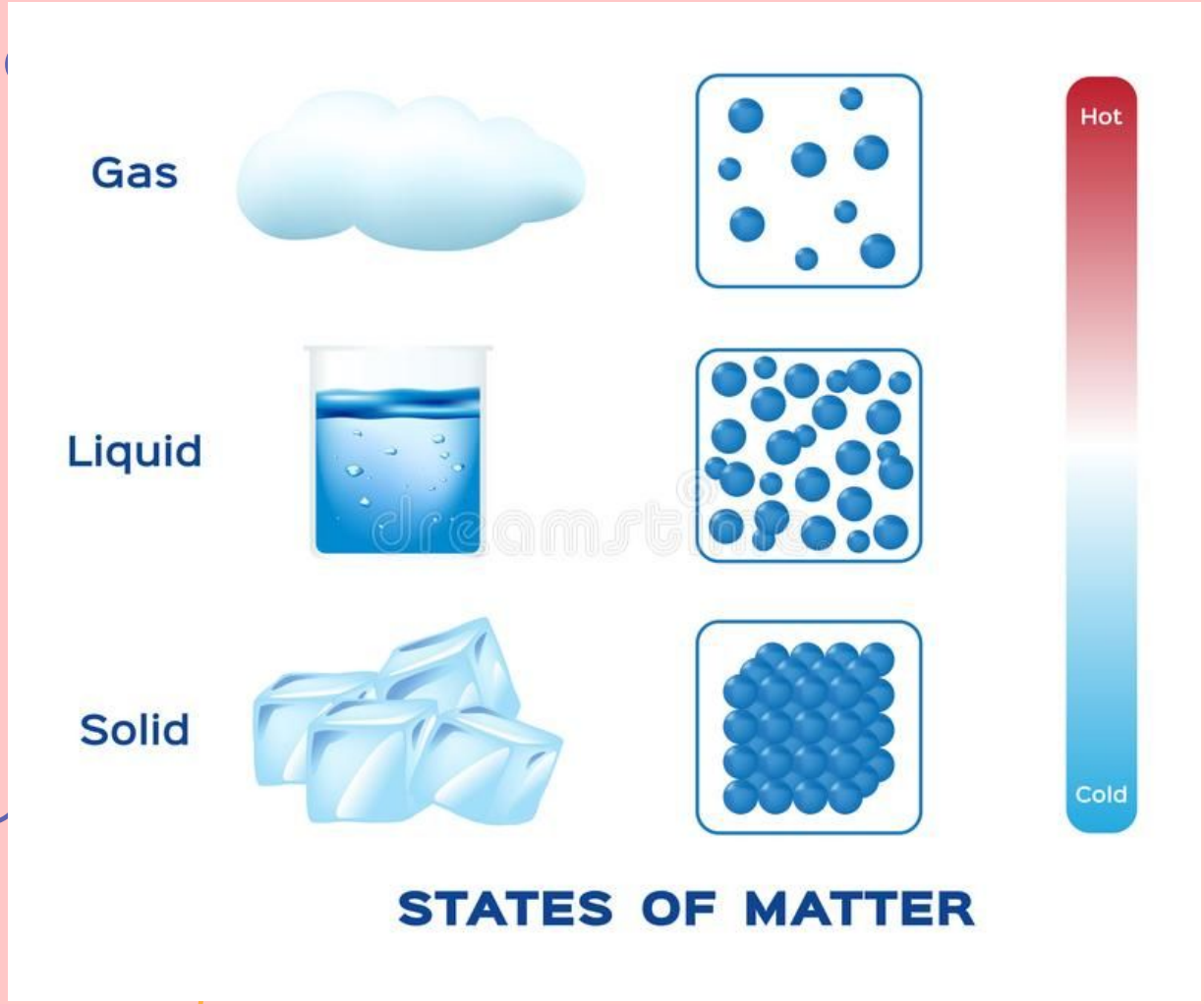
Question!

Water can take the form of ice , which we use to cool things down, liquid water that we drink, and steam from when we cook.

What is the difference between the forms of water at a particulate level?

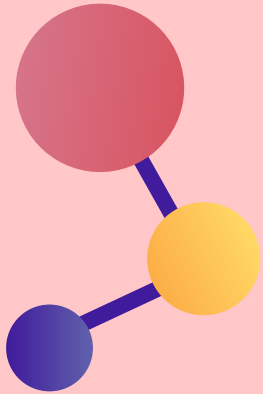





Gas
Liquid
Solid
Hot
Cold
STATES OF MATTER

To Summarize:

- What is matter and Chemistry?
- What is the particulate theory of matter and its main ideas?
- What are the states of matter?
- What are examples of matter in various states?



Evidence of The Particulate Theory

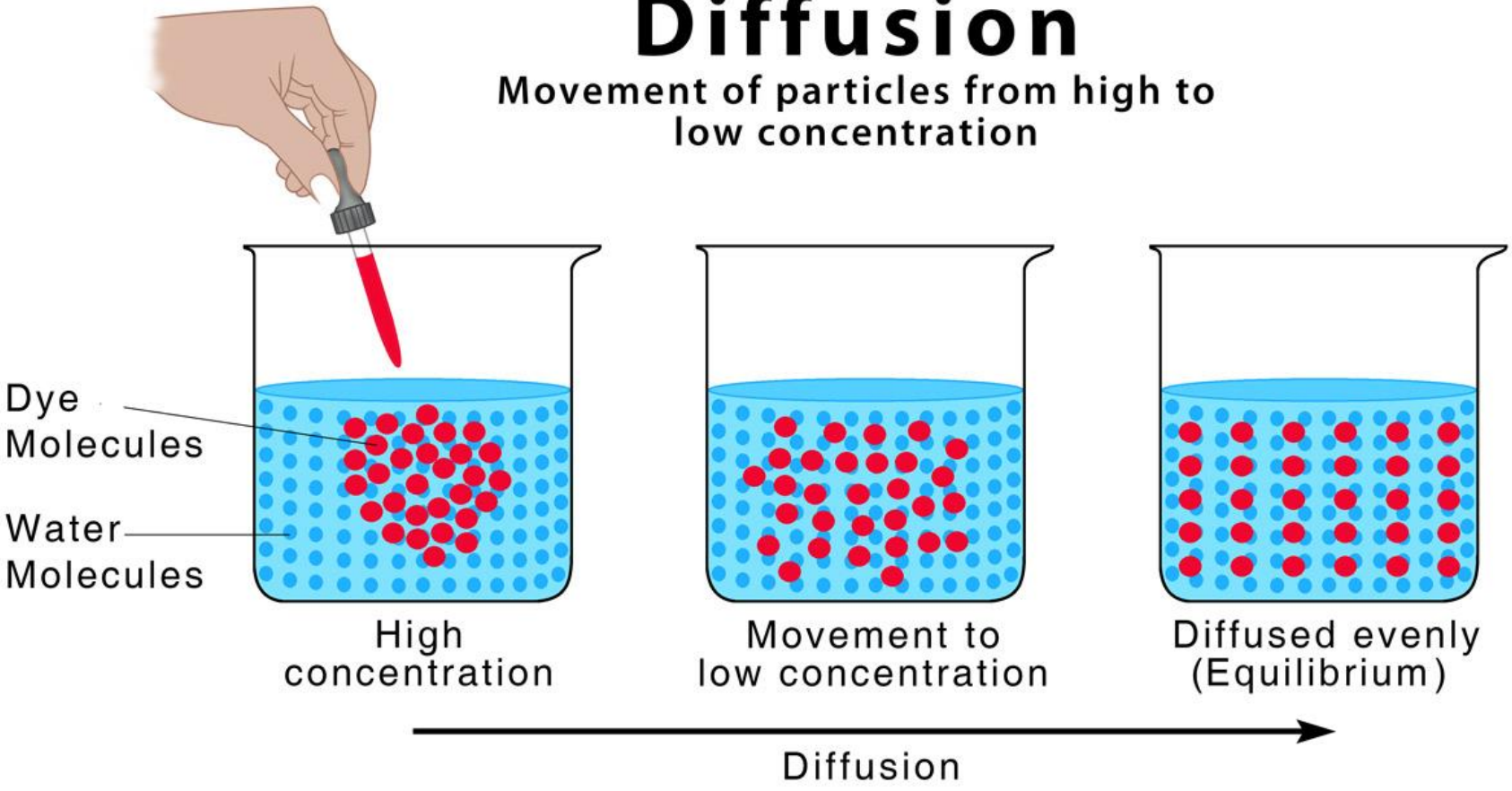
Diffusion

- Diffusion is the net movement of particles from a region of **higher concentration** to a region of **lower concentration**, until the particles are evenly distributed.

- Particles in **gases and liquids** are capable of diffusing.

Diffusion

Movement of particles from high to low concentration



ScienceFacts.net

Osmosis

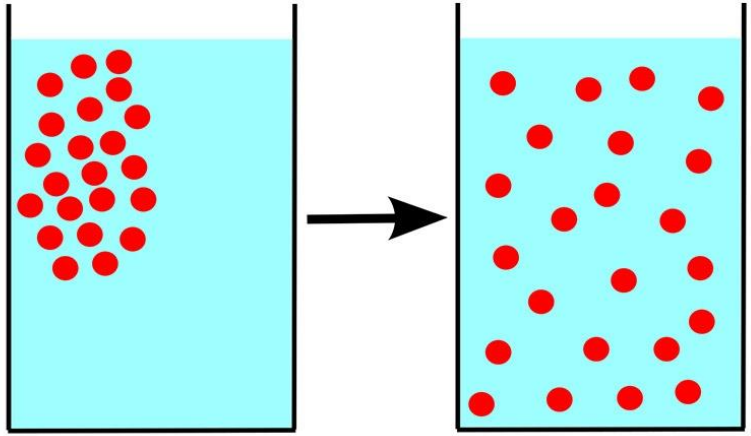
- Osmosis is the movement of **water molecules** through a semi-permeable membrane from a solution containing a lot of water molecules, e.g. a dilute solution (or water), to a solution containing fewer water molecules, e.g. a concentrated solution.

- Only particles in **liquids** can undergo osmosis

Diffusion

Movement of molecules from high concentration to low concentration

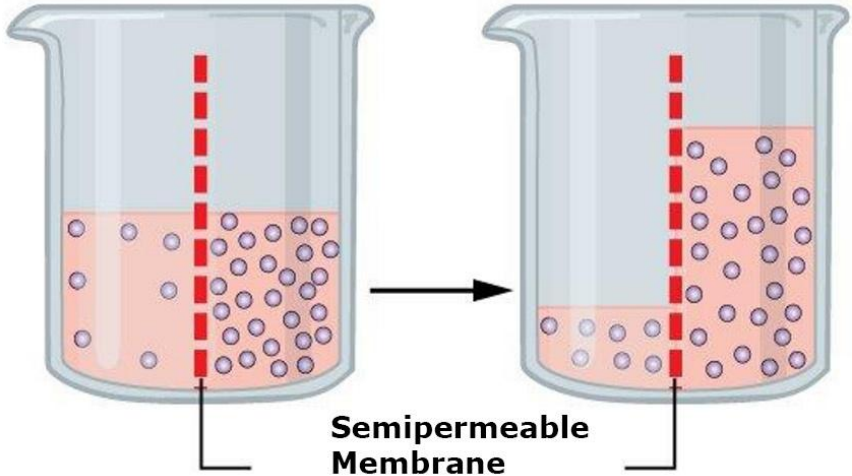
Both solute and solvent move



Osmosis

Movement of solvent (water) across a semipermeable membrane from high to low solvent concentration

Only solvent moves



Uses of Osmosis

To control garden pests

- Slugs and snails are garden pests, whose skin is differentially permeable and always moist. When salt (sodium chloride) is sprinkled on slugs and snails, it dissolves in the moisture around their bodies forming a concentrated solution. Water inside their bodies then moves out by osmosis and into the solution. The slugs and snails die from dehydration if their bodies lose more water than they can tolerate.

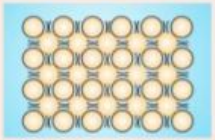
Uses of Osmosis

To preserve food

Salt and sugar are used to preserve foods such as meat, fish and fruit. They both work in the same way:

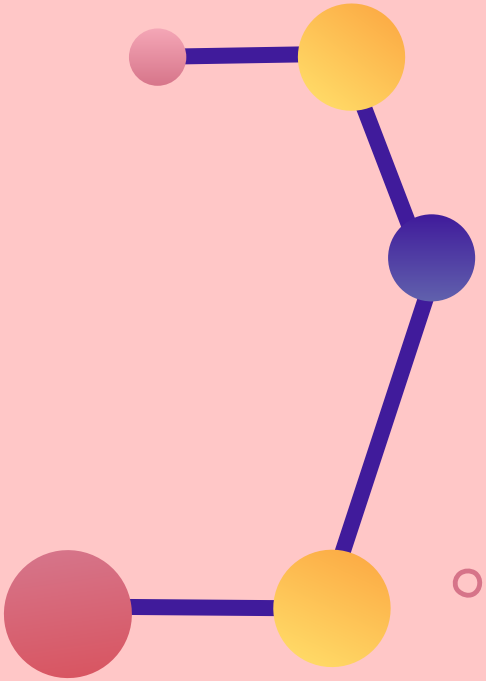
- They draw water out of the cells of the food by osmosis. This prevents the food from decaying because there is no water available in the cells for the chemical reactions which cause the decay.
- They draw water out of microorganisms (bacteria and fungi) by osmosis. This prevents the food from decaying because it inhibits the growth of the microorganisms that cause decay

Additional Comparisons between the States of Matter

Property	Solid	Liquid	Gas
Shape and volume	Solids have a fixed shape and a fixed volume.	Liquids do not have a fixed shape, but they have a definite volume. Liquids take the shape of the part of the container that they occupy and the surface is always horizontal.	Gases do not have a fixed shape or volume. A gas will take up the space of the container it is placed in. The shape and volume of a gas is, therefore, the shape and volume of the entire container it is in.
Density	Most solids have a high density.	The density of liquids is usually lower than the density of solids.	Gases have a low density.
Compressibility	Solids are very difficult to compress.	Liquids can be compressed very slightly when pressure is applied.	Gases are easy to compress.
Arrangement of the particles	The particles are packed closely together, usually in a regular pattern.	The particles are randomly arranged and have small spaces between them.	The particles are randomly arranged and have large spaces between them.
Forces of attraction between the particles	The particles have very strong forces of attraction between them.	The forces of attraction between the particles are not as strong as those between the particles of a solid.	The particles have very weak forces of attraction between them.
Energy and movement of the particles	Particles in a solid have very small amounts of kinetic energy. The particles vibrate in their fixed position.	Particles in a liquid have more kinetic energy than particles in a solid. The particles move about slowly.	Particles in a gas have large amounts of kinetic energy. The particles move about freely and rapidly.
Arrangement of particles			

Changing States

How matter can change from one state to another



Changing States

Matter can exist in any of the three states depending on its temperature. It can change from one state to another by heating or cooling, as this causes a change in the kinetic energy and arrangement of the particles:

Changing States

- When a solid is **heated**, it usually changes state to a liquid and then to a gas. This occurs because the particles **gain** kinetic energy, move increasingly faster and further apart, and the forces of attraction between them become increasingly weaker.

Changing States

Melting- the action/ process of a solid becoming a liquid

Evaporation is the process by which particles of a liquid leave the surface of the liquid as a vapour.

Boiling is the process by which a liquid is freely converted to gas or vapour at its boiling point.

Changing States

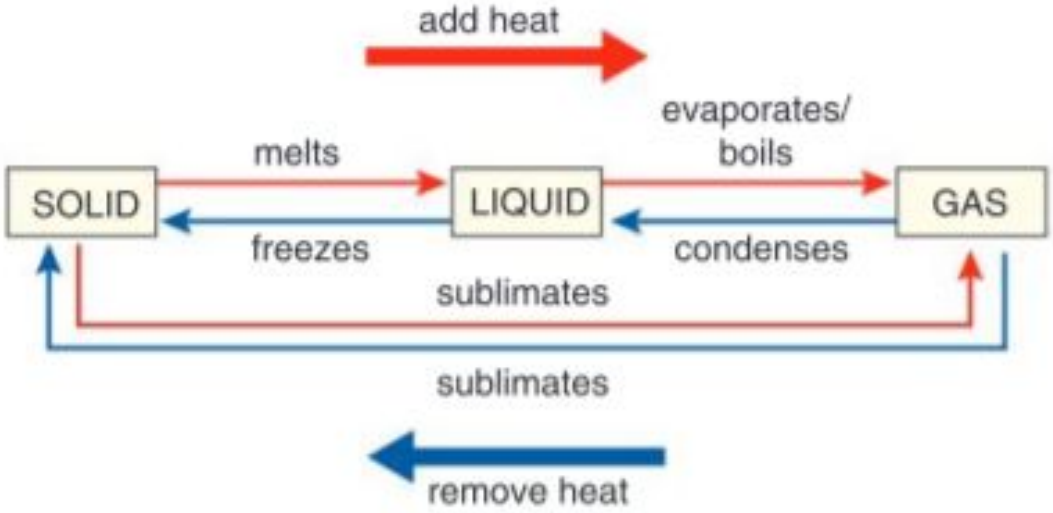
- When a gas is **cooled,** it usually changes state to a liquid and then to a solid. This occurs because the particles **lose** kinetic energy, move more and more slowly and closer together, and the forces of attraction between them become increasingly stronger.

Changing States

Freezing- the action/ process of a liquid becoming a solid

Condensation- the process of a gas becoming a liquid

Changing States



Changing States

Evaporation and boiling are different in the following ways:

- Evaporation can take place at any temperature, whereas boiling occurs at a specific temperature.
- Evaporation takes place at the surface of the liquid only, whereas boiling takes place throughout the liquid.

Changing States

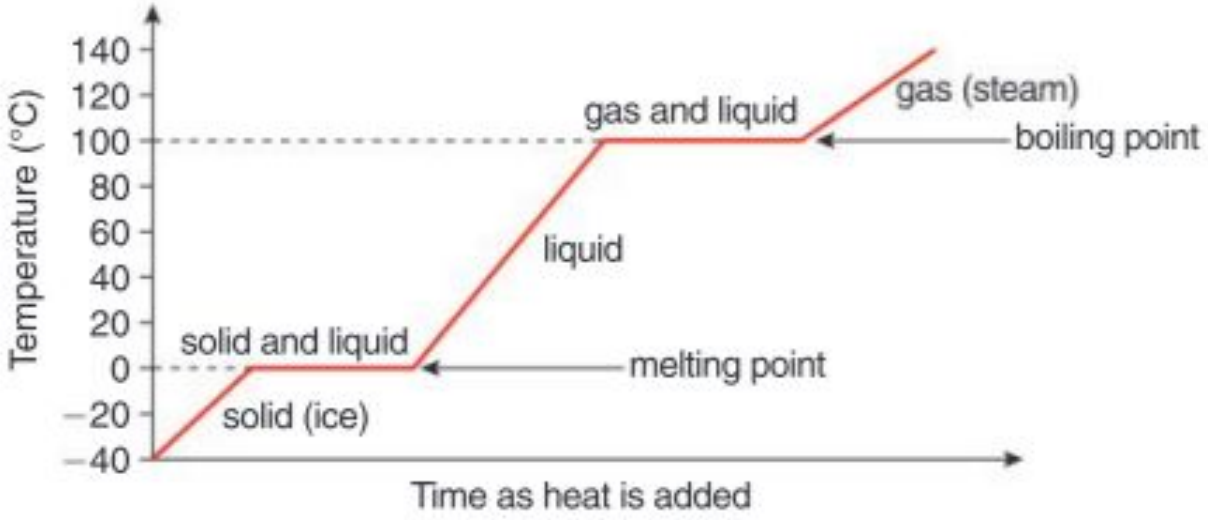
Substances which sublimate (or sublime) change directly from a solid to a gas. The reverse process in which a gas changes directly to a solid is called deposition. Examples of substances that sublimate include carbon dioxide ('dry ice'), iodine and naphthalene (moth balls).

Heating and Cooling Curves

- A **heating curve** is drawn when the temperature of a solid is measured at intervals as it is **heated** and changes state to a liquid and then to a gas, and the temperature is then plotted against time.

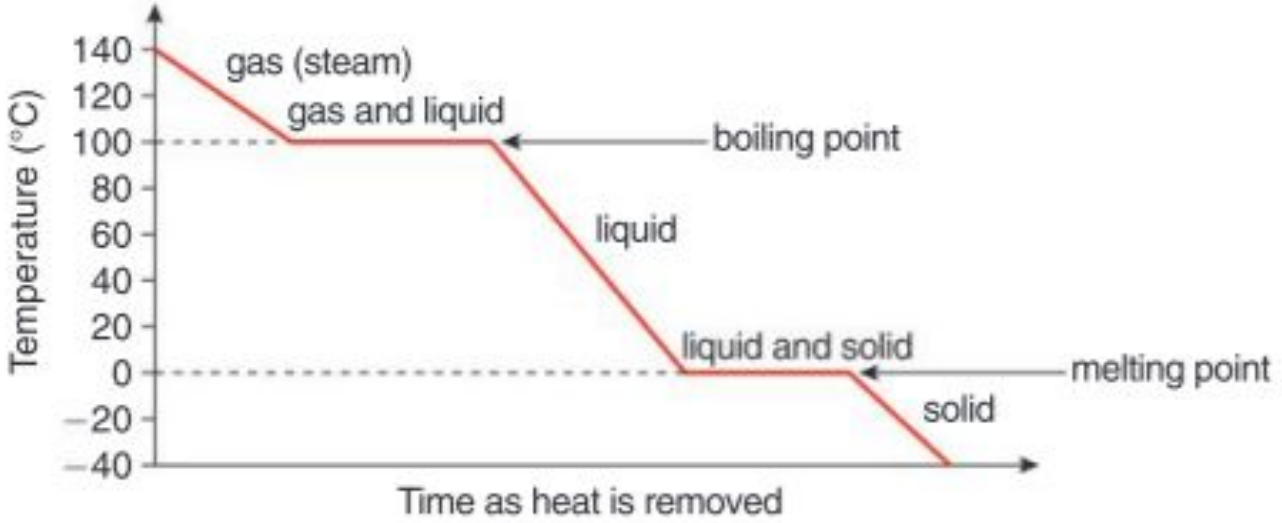
- A **cooling curve** is drawn when the temperature of a gas is measured at intervals as it is **cooled** and changes state to a liquid and then to a solid, and the temperature is then plotted against time.

Heating Curves



Heating curve of water

Cooling Curves



Cooling curve of water

Heating and Cooling Curves

- The melting point is the constant temperature at which a solid changes state into a liquid.
- The boiling point is the constant temperature at which a liquid changes state into a gas.
- The freezing point is the constant temperature at which a liquid changes state into a solid.

Note The melting and freezing points of any pure substance have the same value.