



Matter

Mass

Everything around us is made up of matter, even the air!

All matter has a set of basic **general properties**.

Mass is a measure of the **amount** of matter in an object.

- Mass measures the **quantity of matter** regardless of both its location in the universe and the gravitational force applied to it.

The unit in the metric system (international system) is the kilogram (kg).



Volume



Volume is the quantity of three-dimensional space enclosed by a surface. Volume is the **space** that a substance or three dimensional shape occupies or contains. Volume is often quantified numerically using the **cubic metre** (m^3).

- Volume is the **space** that occupies a entity.
- It can be solid, liquid or gas.

The Characteristics of Matter

The various properties of matter are specific to the **type** of substance. Rather, the properties of each substance are different.

- Hardness (how difficult is it to scratch)
- Density
- Solubility (in water or other liquids)
- Electric conductivity
- Melting point and boiling point

These **characteristic properties** are specific for each substance and help us to identify the substance.

Characteristic Properties

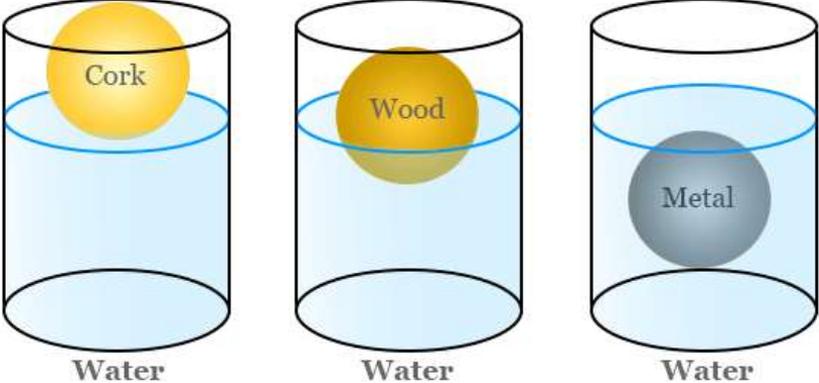
- Characteristic properties are always the same, whether the object is **large** or small.
- Characteristic properties can be **physical** or **chemical**.
- **Examples:**
 - Density
 - Solubility
 - Reactivity
 - Boiling Point
- **Examples that are NOT:**
 - Size
 - Volume
 - Shape
 - State of Matter

Density

The amount of mass for each unit of volume.

DENSITY FORMULA

Density of Cork < Wood < Metal →



The diagram shows three identical cylinders filled with water. The first cylinder contains a yellow cork ball that is partially submerged. The second cylinder contains a yellow wood ball that is also partially submerged. The third cylinder contains a grey metal ball that is fully submerged and resting at the bottom. Labels 'Cork', 'Wood', and 'Metal' are placed inside their respective cylinders. Below each cylinder is the word 'Water'.

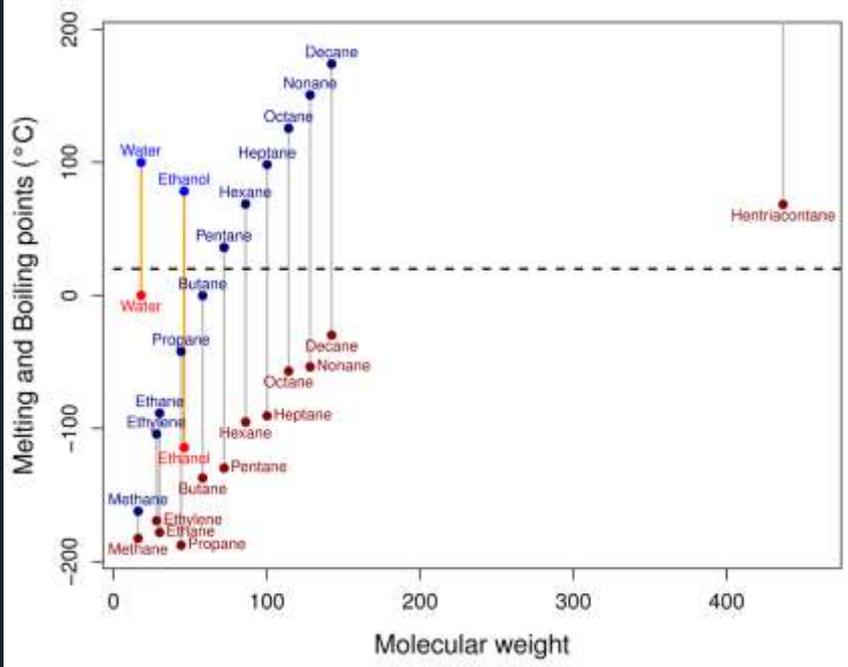
Water Water Water

density → $\rho = \frac{m}{V}$

← mass
← volume

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Melting Point and Boiling Point



Melting point: The temperature at which a substance melts.

Boiling Point: The temperature at which a substance boils.

Every substance has a distinct temperature at which it melts or boils.



Kinetic Molecular Theory

All substances and materials are made up of particles. These particles can be molecules or atoms.

- **Atoms** are single neutral particles. **Molecules** are neutral particles made of two or more atoms bonded together.
- These particles are **constantly moving**.

The **kinetic molecular theory** helps to explain the three states of matter. Key points:

- All particles have **energy**, and the energy varies depending on the **temperature** of the matter, which then determines if the substance is a solid, liquid, or gas.
- Solid particles have the least amount of energy, and gas particles have the greatest amount of energy.
- The **temperature** of a substance is a measure of the **average kinetic energy of the particles**. A change in phase may occur when the energy of the particles is changed.

Kinetic Molecular Theory

Solids: Fixed and ordered particles that are very close together. Their movement is a vibration.

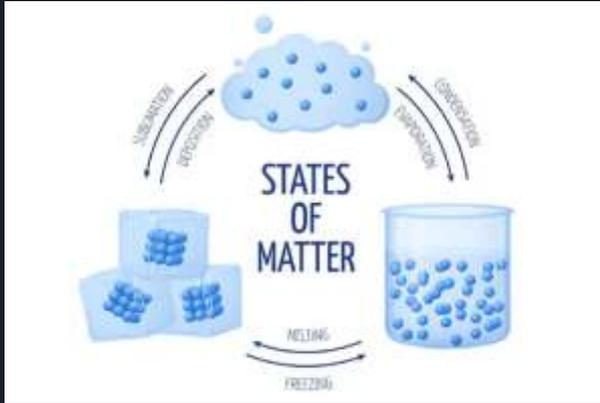
- Constant form, constant volume, high density
- Little space between particles

Liquids: Particles are more separated than in the solid state. They have more mobility and move around each other.

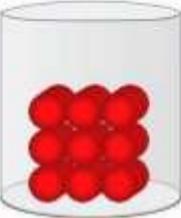
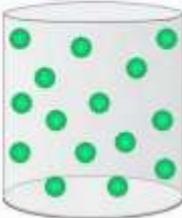
- Varied (changing) form, constant volume, medium density
- More space between particles

Gases: Particles are very separated. The particles can move freely and at high speeds.

- Variable form, variable volume, very low density
- Lots of space between particles



Kinetic Molecular Theory

solid	liquid	gas
		
<ul style="list-style-type: none">● rigid● fixed shape● fixed volume	<ul style="list-style-type: none">● not rigid● no fixed shape● fixed volume	<ul style="list-style-type: none">● not rigid● no fixed shape● no fixed volume
cannot be squashed	cannot be squashed	can be squashed

SOLIDS, LIQUIDS, GASES

We can put materials into these three groups which are called the three states of matter.

SOLIDS

ICE BRICK WOOD IRON

All materials, whether they are solids, liquids or gases are made up of tiny particles, called atoms or molecules.

LIQUIDS

PETROL VINEGAR PAINT WATER

The arrangement and energy of the particles are different in solids, liquids and gases.

GASES

HELIUM OXYGEN CARBON DIOXIDE HYDROGEN

Water is the ONLY material found naturally on Earth in all three states.

SOLID (Ice) LIQUID (Water) GAS (Steam)



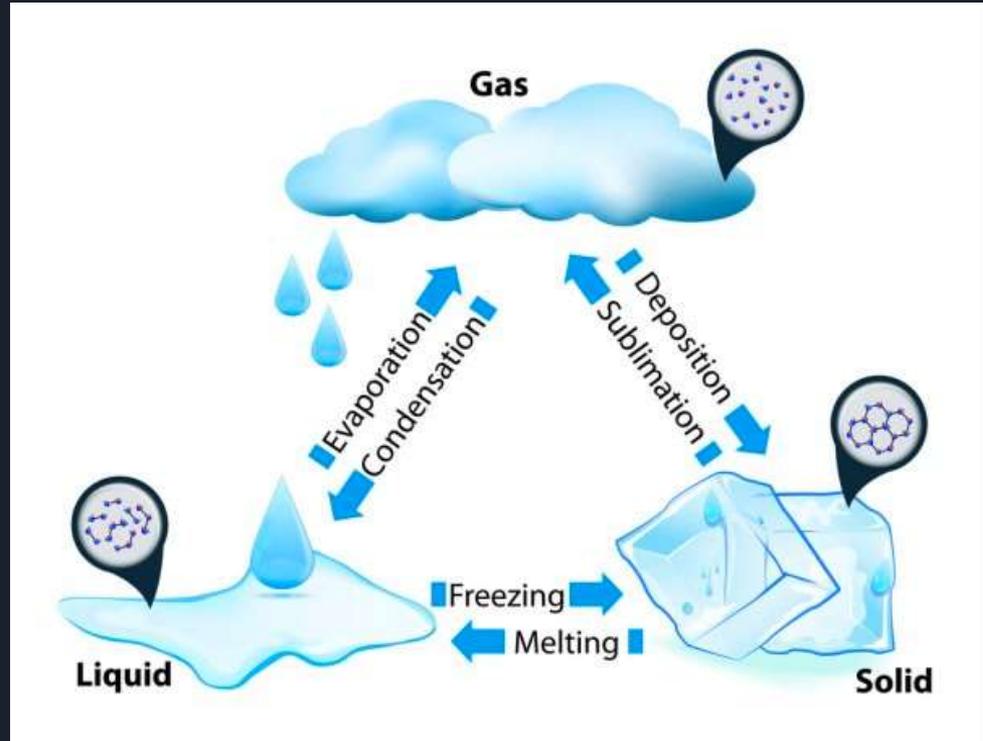
Video

<https://www.youtube.com/watch?v=ELchwUIIWa8>

<https://www.youtube.com/watch?v=DE3LCPfP8N8>

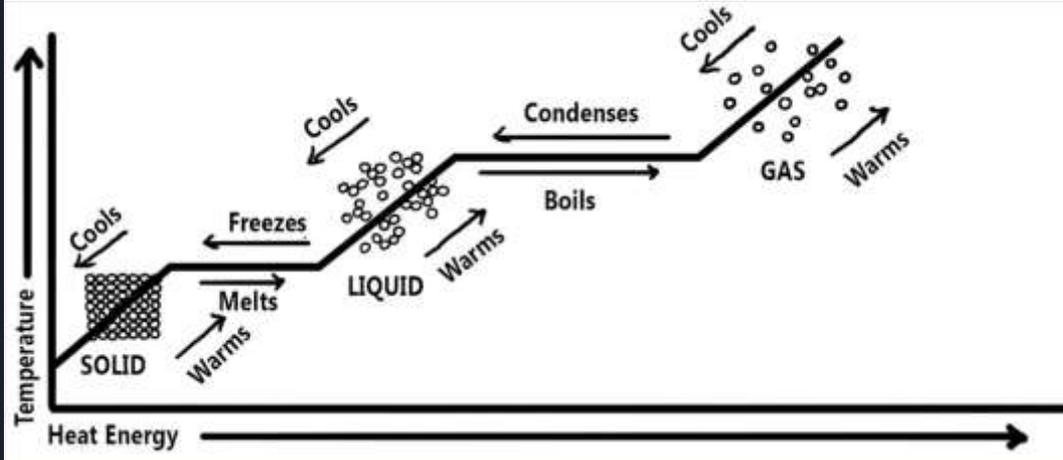
Changes of State

Matter changes state according to its surroundings. Each change of state has a specific name. In some cases, **heat is absorbed** (melting and vaporization) and, in others, **heat is released** (condensation and solidification).



The Melting Point

The **melting point** is the temperature at which the matter changes **from a solid to a liquid state**. The temperature remains **constant** during the process of melting. If we heat up ice cubes, we will see that they start to melt at 0 degrees celsius and the temperature remains at 0 degrees celsius.



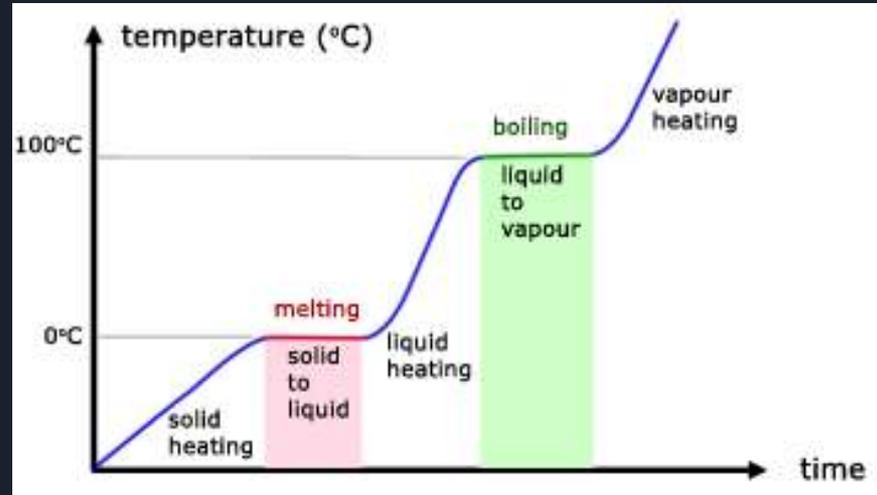
- The temperature remains constant during melting
- The melting point is a characteristic property

The Boiling Point

The **boiling point** is the temperature at which matter **changes from a liquid to a gas state**. The temperature also remains constant during the boiling process.

Water changes to a gaseous state at 100 degrees celsius, and the temperature remains constant. The state change lasts for **200 seconds**.

The boiling point, like the melting point, is a **characteristic property** of the substance, so it can be used to identify substances.



Matter

General Properties

like

Mass

Volume

Specific Properties

like

Density

Hardness

Solubility

Electrical
conductivity

Melting point

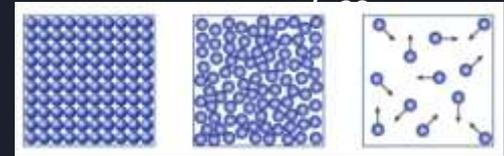
Boiling point

That serve to identify them

comes in 3 states

Solid

Liquid



that can change state

