



**Matter**

# Mass

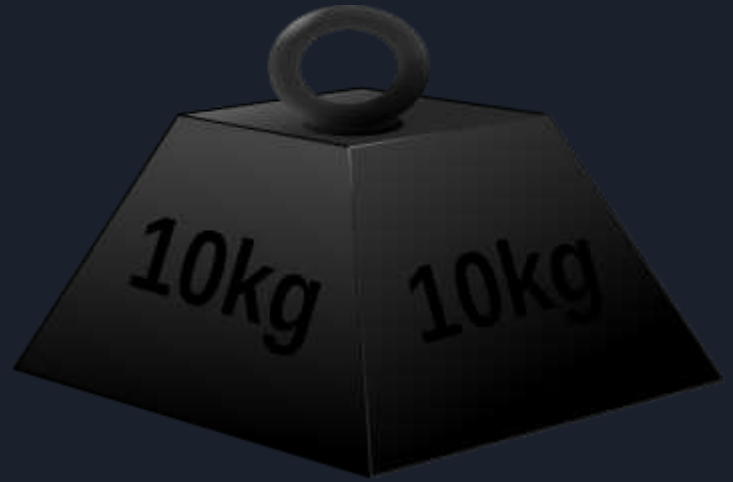
Everything around us is made up of matter, even the air!

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 an 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

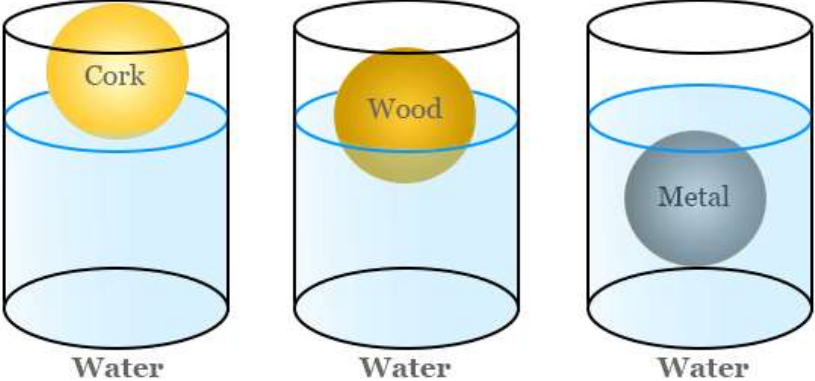
- Characteristic properties are always the same, whether the object is **large** or small.
- Characteristic properties can be **physical** or **chemical**.
- **Examples:**
  - Density
  - Solubility
  - Reactivity
  - Boiling Point
- **Examples that are NOT:**
  - Size
  - Volume
  - Shape
  - State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

# Density

The amount of mass for each unit of volume.

**DENSITY FORMULA**

Density of Cork < Wood < Metal →



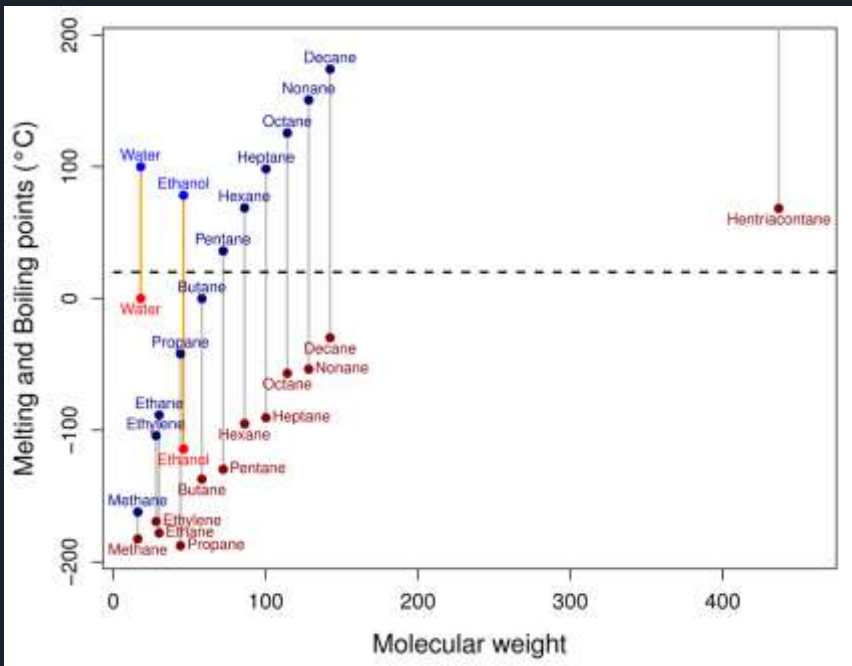
The diagram shows three identical cylinders, each labeled 'Water' at the bottom. The first cylinder contains a yellow sphere labeled 'Cork' that is partially submerged. The second cylinder contains a yellow sphere labeled 'Wood' that is also partially submerged. The third cylinder contains a grey sphere labeled 'Metal' that is fully submerged at the bottom.

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"><li>● rigid</li><li>● fixed shape</li><li>● fixed volume</li></ul>	<ul style="list-style-type: none"><li>● not rigid</li><li>● no fixed shape</li><li>● fixed volume</li></ul>	<ul style="list-style-type: none"><li>● not rigid</li><li>● no fixed shape</li><li>● no fixed volume</li></ul>
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)



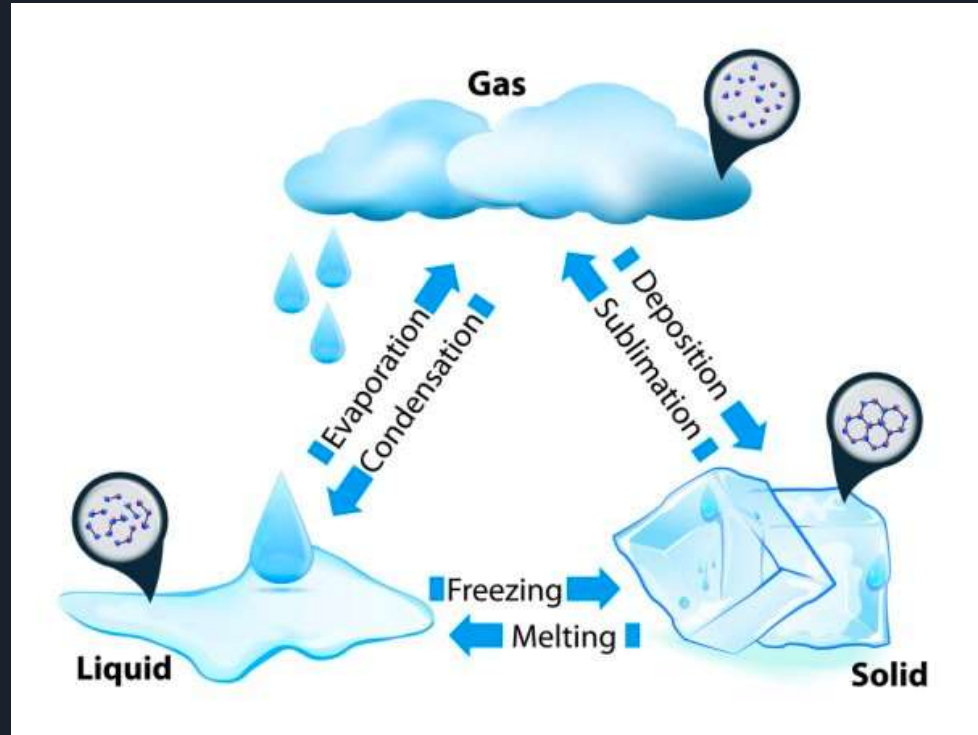
# Video

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

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

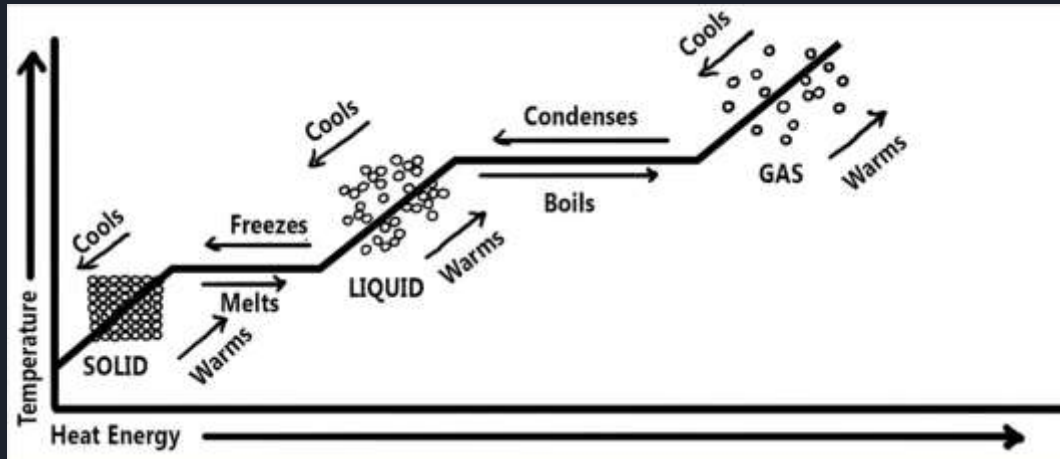
# Changes of State

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.



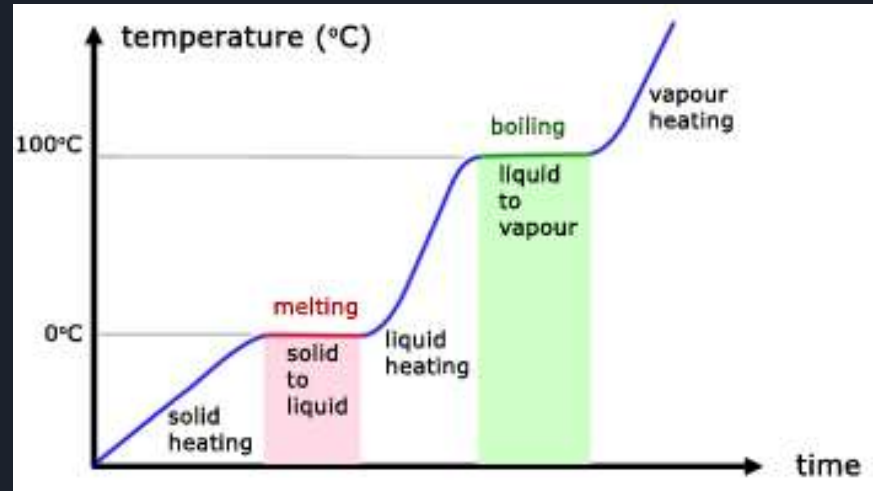
- The temperature remains constant during melting
- The melting point is a characteristic property

# 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

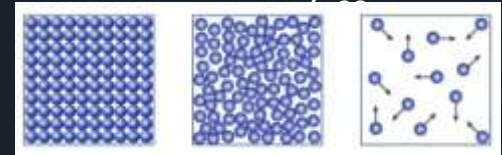
Boiling point

That serve to identify them

comes in 3 states

Solid

Liquid



that can change state

