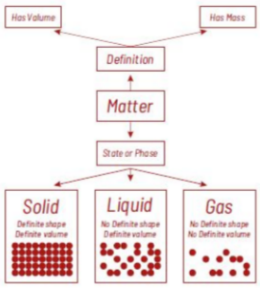
Key concept is form.



An inquiry into 'matter' I how particles together make matter.
So, what's matter? Anything that has 'mass' is made up of 'matter' !

An all-encompassing word for atoms and molecules that make up our physical world. Matter exists in States or phases.

Most people are familiar with three states of matter - solids, liquids and gases - but there are two more that are less commonly known but just as important - plasmas and Bose-Einstein condensates.

A recap on: Three states of matter

Solids, liquids and gases are three states of matter. In solids, the particles are tightly packed together. In liquids, the particles have more movement, while in gases, they are spread out. Particles in chemistry can be atoms, ions or molecules.

It is important to understand the ***'particle nature of matter'. The particles that make up matter are not 'small bits of solid' or 'small drops of liquid' but atoms and molecules.*** The physical characteristics of those atoms and molecules decide its state.

Solid

Something is usually described as a solid if it can hold its own shape and is hard to compress (squash). The molecules in a solid are closely packed together - they have a high density.

Right now, you are probably sitting on a chair, using a mouse or a keyboard that is resting on a desk - all those things are solids.

Gallium crystal

Gallium is an uncommon metal that exists in a liquid and solid form. This gallium crystal would melt if you handled it.

Liquid

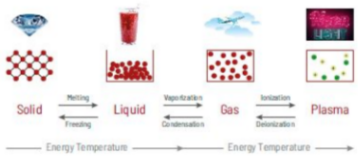
In liquids, the molecules have the ability to move around and slide past each other. A liquid will take on the shape of the container it is being held in. While a liquid is easier to compress than a solid, it is still quite difficult - imagine trying to compress water in a confined container! Water is an example of a liquid, and so is milk, juice and the petrol you put in the car.

Gas

In gases, the atoms are much more spread out than in solids or liquids, and the atoms collide randomly with one another. A gas will fill any container, but if the container is not sealed, the gas will escape. Gas can be compressed much more easily than a liquid or solid.

Right now, you are breathing in air - a mixture of gases containing many elements such as oxygen, nitrogen and carbon.

The gaseous state is truly chaotic on the molecular level. It is the rapid, random motion of the spaced out gaseous particles that supports this description. This kinetic-molecular model helps to explain some of the properties of gases.



The Plasma State

Our daily experience confirms a world made up of solids, liquids and gases. However, at about 80 km above the Earth's surface, the atmosphere is no longer made up of gas. Instead, it is made up of ionised gas, which consists of a balanced mix of electrons, positive ions and neutral particles. This state is called plasma.

Plasma is very similar to gas, in fact, the easiest way to describe plasma is as a gas that can carry an electrical charge. Plasma is a form of matter that exists when atoms are in an excited state. They are so excited that they jump an energy level and, in doing so, give off light. Plasma particles are spread out and move around randomly, but unlike gas, they contain some free ions and electrons, which gives plasma its ability to conduct electricity.

On Earth, plasmas are commonly found in some kinds of fluorescent lights and neon signs. Another form of plasma on Earth happens during storms as lightning.

Lightning

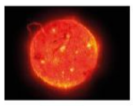
A lightning storm is an example of plasma, one of the known states of matter. Plasma is atoms in a very excited state and giving off light.

Auroras

Auroras are another form of plasma, where atoms in the upper atmosphere are affected by particles coming in from outer space.

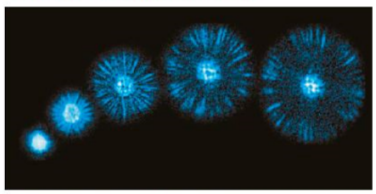
The most common form of plasma is in the stars - our Sun exists in the plasma state.

Overall, plasmas are the most common state of matter - they make up 99% of the visible universe.



Bose-Einstein Condensate (BEC)

To understand a Bose-Einstein condensate (BEC), you must first know a bit about temperature.



There is a temperature at which molecular motion (therefore everything) stops, this is called absolute zero (0K or around -273°C). Just a fraction above this temperature - and only for some elements - a BEC occurs.

The atoms start behaving like little waves and start overlapping one another until they eventually act like one wave and essentially become a super atom. They are not bonded or mixed - they have become indistinguishable from one another, having the same qualities and existing in the same place.

Daniel Kleppner from the Massachusetts Institute of Technology has a great description. He says the *'particles have lost their identity - they all think they are everywhere'*. One atom can't tell itself form another.