

Lesson #1: Matter and it's changes

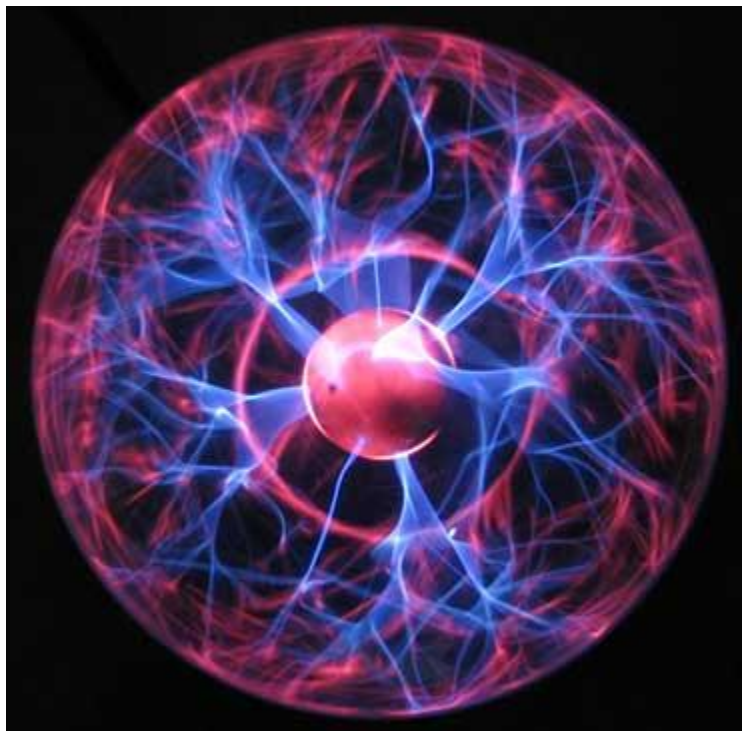
Matter – anything that has mass and occupies volume.

- Matter has 4 states that it can exist in:

Table 2 The States of Matter and the Kinetic Molecular Theory

Solids Distance: particles close together Type of motion: particles can only vibrate in their place in the structure Attractive Forces: high, decreasing as vibrations get larger Energy: increasing energy causes an increase in vibration	 
Liquids Distance: particles close together Type of motion: particles still vibrate, but can now move past one another; can bump into each other and the sides of their container Attractive Forces: still quite high, but less than solids and decreasing with distance apart Energy: increase in energy causes an increase in vibration and movement	 
Gases Distance: particles very far apart Type of motion: particles vibrate, rotate, move past each other, and bump into each other in a very rapid straight line motion Attractive forces: no attractive forces; particles are too far apart and are moving too fast Energy: increase in energy causes an increase in pressure due to the increase in the speed and number of particles hitting the sides of the container	 

Plasmas – ionized gases that are strongly affected by magnetic fields.



***Orally:** Do not confuse phase with state. These terms are often used interchangeably and they are not exactly the same.*

Phase - a region of material that is chemically uniform, physically distinct, and (often) mechanically separable. In a system consisting of water and oil at room temperature, there is only one state of matter, but there are two distinct phases of matter due to the boundary that exists between the oil and the water.

***Orally:** We will discuss phase change (i.e., phase transition) diagrams later in the course.*

Pure Substance: One kind of matter throughout the entire sample. Each kind of matter has a set of unique and identifiable properties. Pure Hydrogen gas would only contain hydrogen and nothing else. Pure water would only contain water, etc. When a pure substance is heated, the temperature will gradually rise until boiling starts. If the substance is not pure, the temperature will continue to climb after boiling has begun.

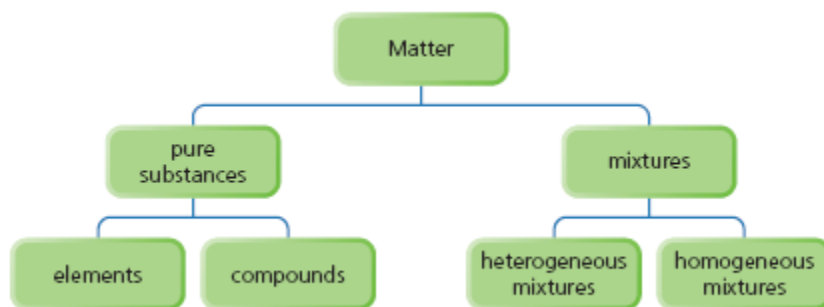
Elements – A substance that cannot be separated into simpler substances by chemical means. Elements contain only one kind of atom. (See periodic table of elements)

Atom – Smallest unit of an element that retains the properties of that element.

Ion – An atom or molecule which has an electrical charge due to the gain or loss of electrons.

Compound – a class of substances that are made up of two or more elements that are chemically bound in a fixed ratio. (i.e., the elements are not simply mixed). e.g., Water is made of 2 hydrogen atoms and 1 oxygen atom (H_2O).

Molecules – substances that are made up of two or more atoms that are chemically bound. e.g., H_2 is a molecule of an element while H_2O is a molecule of a compound.



Mixture – a combination of two or more pure substances that are “mixed” together but do not chemically bind to each other.

- a. **heterogeneous mixture** (i.e., mechanical mixtures) – mixtures that contain particles that are visibly distinguishable. These mixtures are not uniform in composition. e.g., trail mix, “nuts and bolts”

Oral: Can you think of other mixtures that can be described as heterogeneous?

How can we show that these mixtures are not uniform throughout the sample?

- b. **Homogeneous mixture (i.e., “true” Solutions)** – mixtures where the individual components cannot be distinguished from each other (i.e., same phase). These mixtures are uniform throughout the sample. e.g., Iced-tea, air, alloys

Oral: Same question as above.

Properties – the characteristics that are specific to a pure substance. Properties are classified two general ways:

1. **Physical properties** – properties that you can observe, measure or calculate.

Oral: Q: Can you think of some physical properties of matter?

e.g., density, state at room temperature, colour, melting/boiling point and conductivity, hardness and crystal cleavage patterns (i.e., these are referred to as **intensive properties** and depend only on the nature of the substance).

(Note: mass and volume alone are never used to identify substances. These are referred to as **extensive physical properties** which depend on the amount of substance.)

Q: How can a physical property such as melting point be used to identify a substance?

A: Different substances have unique properties so their melting points could be different. If a substance was liquid at room temperature and started to solidify at temperatures below 0°C, that substance might be water. If, however, the liquid only began to freeze at -20°C then we could rule out water.

Density – the mass per unit volume of a substance. Density = mass/volume. The units are g/cm³ which is the same as g/mL. Therefore if we know both the mass and volume of any object we can calculate the density of the object.

Q: If the mass of a sample of water is 50.0g and occupies 50.0mL, what is the density of water?

A: density = 50.0g/50.0mL = 1.0g/mL

Q: If the mass of ethanol is 51.0g and has a volume of 50.0mL, what is the density of ethanol?

A: density = 51.0g/50.0mL = 1.02g/mL

Conductivity – the ability of a material to conduct either electricity or heat.

e.g., copper is a good electrical conductor b/c electricity easily flows through it.

e.g., an oven mitt is a poor conductor of heat b/c heat flows through it more slowly.

2. **Chemical Properties** – describes the way a given substance reacts as it is converted into a new substance(s).

e.g., flammability, corrosion and reactions with acids are three chemical properties that can be used to identify a specific substance or group substances with similar properties.

Corrosion – the undesired reaction of metals with oxygen.

e.g., rusting is the corrosion of Iron.

Reactions with acids – Many metals produce hydrogen gas when they react with acids, while many substances such as sodium bicarbonate form carbon dioxide gas when mixed with acids.

Assignment: Hebden workbook pg.44 #13, 15, pg.48 # 24 – 26 and pg.52 #33 – 39, 41, 43, 44