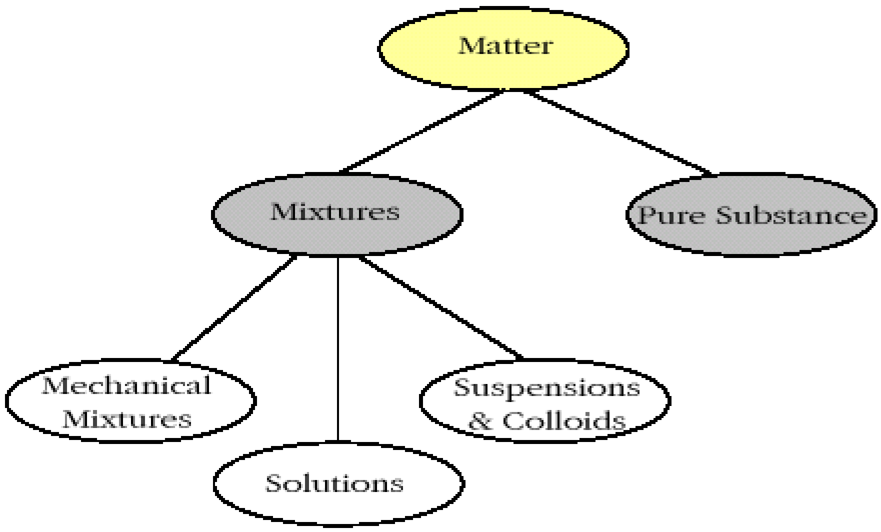
2.0 The properties of mixtures and fluids can be explained by the particle model of matter

2.1 Pure Substances and Mixtures

- All pure substances have their own unique set of properties, or characteristics
  All mixtures contain two or more pure substances, which have their own distinct properties (some of which may be hidden)

  Classification of Matter Chart (p.20)



Homogenous Mixtures
- are mixtures which look as though they have only one set of properties.
- the blended mixture has equal amounts of both substances (all parts of the mixture are the same)
- if the homogenous mixture does not have any settling of any of the substances it is made of, then it is called a solution
- solutions occur because each particle slips between each other particle and is evenly distributed throughout the entire mixture

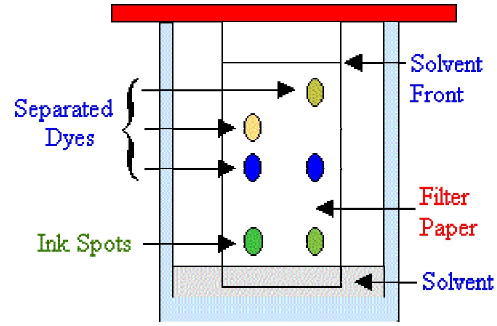
Heterogenous Mixtures
- the properties of the pure substances, in a heterogeneous mixture, are not hidden
- if there are two or more materials that are visible within a mixture, then it is called a heterogeneous mixture

In-Between Mixtures
- a heterogeneous mixture, in which the particles settle slowly after mixing, is called a **suspension** (eg. orange juice)
- a heterogeneous mixture, in which the particles do not settle at all, is called a **colloid** (eg. fog)
- to disperse the particles for a longer period of time, an **emulsifying agent** (like a protein) is used to form an emulsion (eg. mayonnaise)
- mixtures that are obviously two or more substances are called **mechanical mixtures**
the separate parts of the mechanical mixture are called ***phases***.

Paper Chromatography

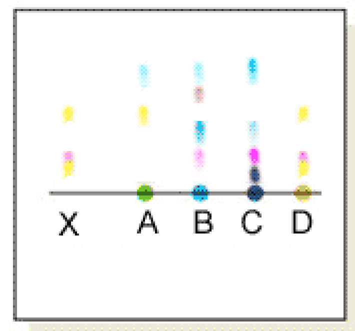
A paper chromatography test can be used to determine if a substance is pure or a solution.

A filter paper is placed partially in a solution – if the fluid moves up to only one level it is a pure substance – if it moves up to multiple levels showing each substance, then it is a solution.



Reading Chromatograms

The filter paper used in the paper chromatography test is called a **chromatogram**.
The distance a substance move up the chromatogram depends on its attraction to the paper. Those with a stronger attraction to the paper don't move up as far as those with a weaker attraction.



Applications

Separation systems are used in a wide variety of industrial and scientific applications. These systems isolate and analyze products that come from mixtures formed during chemical synthesis. Chromatography applications are used in many scientific analyses, including:

- Medical/biomedical research, quality control of pharmaceuticals, routine clinical determination, and drug screening
- Space-related and geo-chemical research and development
- Forensic sciences
- Food and cosmetic chemical measurement
- Process control in the petroleum industry
- Environmental monitoring and pollution control
- Investigation of the chemistry and metabolism of biological systems

2.2 Concentration and Solubility

Forming a solution by mixing two or more materials together is called **dissolving**.
- dissolving occurs because of the attracting between the particles (there may be a stronger attraction to the particles of another substance, than to the particles of the same substance)

Solutes and Solvents

The **solute** is the substance that dissolves in a solvent. The **solvent** is the substance that dissolves the solute to form a solution.
Soluble means to be able to be dissolved in a particular solvent. Solutes and solvents can be gases or liquids.

Measuring Concentration

The **concentration** of a solution is the actual amount of solute in a specific amount of solvent.
example: 50 grams of solute dissolved in 100 ml of water has a concentration of 50g/100ml
(Another common way to express concentration is how much solute is dissolved in a 100 ml of a solvent) Concentration can also be stated as a percentage - ie. 5% (means, 5g/100ml).
Extremely low concentrations are stated in ppm (parts per million).

Comparing Concentrations

To compare concentrations of two solutions, you need to know the amount of solute in the **same volume** of solvent for each solution.

Solution 1	**10g of salt in 50ml of water (10g/50ml)**	**= 20g/100ml**
Solution 2	**25g of salt in 100ml of water (25g/100ml)**	**= 25g/100ml**

***Solution 2** has a higher concentration*

Saturated and Unsaturated Solutions

The limit to concentration is called **solubility**. (The maximum amount of solute that can be dissolved in a fixed volume of solvent at a given temperature.)

- a **saturated solution** is one in which no more solute will dissolve in a specific amount of solvent at a specific temperature (Using the particle theory, the attractive forces between the particles becomes balanced and no more particles of the solute can be attracted by the particles of the solvent)
- an **unsaturated solution** is one in which more solute can be dissolved in a specific solvent at the same specific temperature

Supersaturated Solutions (**Solubility** is a unique property **-** ***Solubility Chart*** (**sia** p. 28)

- a solution that contains more solute than would normally dissolve at a certain temperature is called a super-saturated solution.

2.3 Factors Affecting Solubility

Water - is called the **'universal solvent'**, because it can dissolve so many materials. The term ' ***aqueous*** ' means water. 97% of the water on Earth is Ocean water, 2% is frozen and only about 0.5% is 'usable' (and even this has materials already dissolved in it that can be harmful), Solutions are not only made up of liquids. The chart on p. 29 illustrates other mixtures that can make solutions.

Solubility Changes With Temperature

Solubility increases as the temperature of the solvent increases, because more space is provided between the particles for the solute particles to fit (dissolve) into. The reverse is true for a gas though - as the temperature increases, the solubility of a gas, in a liquid solvent decreases.

Thermal Pollution

This decrease in the solubility of gases can have a serious effect on the environment. If the temperature of water increases (warm industrial waste water poured directly into lakes and rivers) then there is less oxygen that can be dissolved in the water – thus, affecting the living organisms in the water. This is called thermal pollution.

2.4 The Particle Model of Matter and The Behaviour of Mixtures

- All matter is made up of tiny particles. Different substances have different particles.
- The particles are always moving and vibrating
- The particles in matter may be attracted to each other or bonded together
- The particles have spaces between them

The particles flow in a fluid by moving freely past one another and at rest have a flat surface. For this reason, solids do not flow, because at rest, they form a cone-shaped *heap*.

How The Particle Model Explains Mixing Substances

Particles are different sizes and when two substances are mixed, the smaller particles fill the spaces between the larger particles. The particle model also states that particles are attracted to each other. However, in some substances particles can be attracted more to particles in other substances than to its own particles.

Factors Affecting The Rate Of Dissolving

The speed at which the solute dissolves in a solvent is called the **rate of dissolving** and can be affected by:

- **Temperature**
- **Agitation (** *stirring or shaking* **)**
- **Size of pieces (** *surface area exposed* **)**