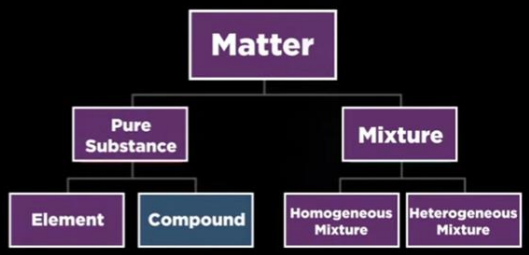
Matter

Is anything that has math and volume, it's made of atoms



Element -> a substance with the same type of atom, for **example** (H_2, O_3, S)

Compound -> a substance consisting of different atoms that are **chemically bonded**, for **example** (NaCl, H_2O), which means that they cannot be broken down by physical means

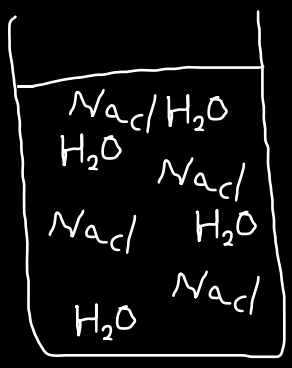
Molecule -> just multiple connected atoms, for **example** (H_2, NaCl)

Mixture -> the result of two or more **pure substances** that are **physically mixed** or can seperated with **physical means,** for **example** (salt water)

Commented [SD1]: As you can separate them physically by just boiling the water so it evaporates, and you'll be left with salt

Mixtures have two types

Homogeneous mixtures -> it means that all substances in a mixture are distributed evenly and every section of it looks the same, **like salt or sugar water**, as it consits of two substances that can be split apart physically, but the mixture looks the same everywhere



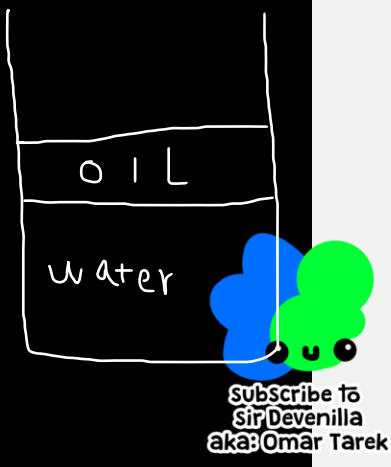
Properties of homogenous mixtures:

- The size of the particles in a homogeneous mixture is smaller than one nanometer.
- The boundaries of separation of the two components are not visible.
- The method to separate the components of a homogeneous mixture can be difficult.
- The components of the mixture are may be present in unequal proportions.
- Components are not apparent to the naked eye.

Heterogeneous mixtures -> it means that the substances in a mixture are not distributed evenly and different sections look different and have a different amount of each substances, like **oil and water**

Properties of heterogenous mixtures:

- The components remain physically separate.
- The separation is easily visible in such mixtures.
- The samples taken from the different places of the mixture may have a different composition.
- There are many easy methods to separate the components of the mixture.
- The components are apparent to the naked eye.



(1) Solutions

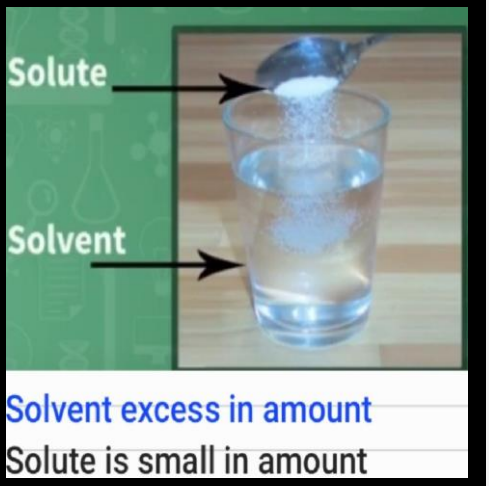
They are homogeneous mixutres with one or more solutes dissolved in the solvent

The particle size in a solution is less than 1 nanometer, where the **solvent** is the component in which the solute dissolves

The **solute** is the component that dissolves in the solvent

It has 3 types

- **A solid solution** where there are 1 or more solutes in a solid solvent **such as alloys like steel**
- **A gaseous solution** is where the solvent is a gas like **air**
- **An aqueous solution** is where the solutes are dissolved in water solvent

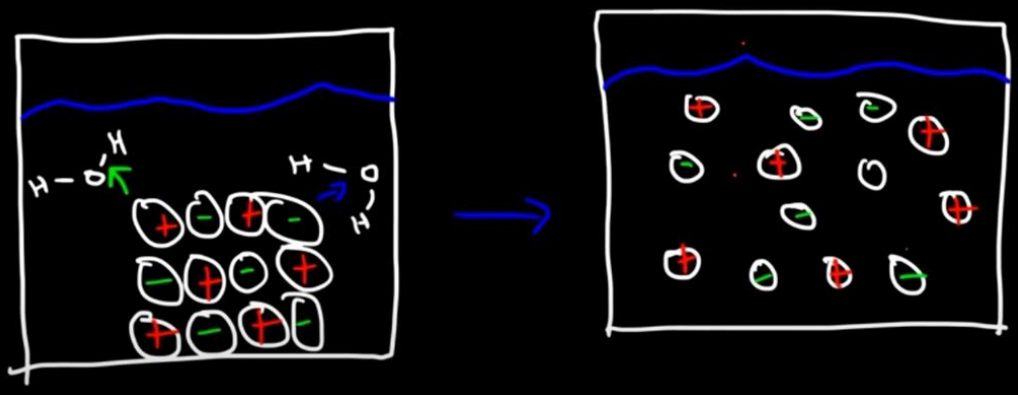


In aqueous solutions

water has **postively charged hydrogen ions** and **negatively charged oxygen ions**, when putting table salt (NaCl) which has **positve sodium cations** and **negative** chloride **anions**, the magnitude in difference between the ions would cause the

oxygen anions **pulling** sodium cations

hydrogen cations **pulling** chloride anions



Concentration of a solution -> the amount of solute in a given solution
concentration = amount of solute / amount of solvent (NOTE)

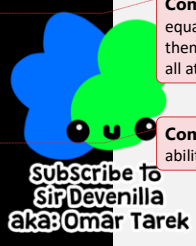
Mass of solution = mass of solute + mass of solvent

Solubility

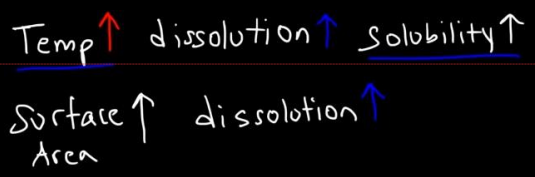
The maximum amount of salute that can be dissolved in givin solvent

Commented [SD2]: You can do that in a chemical equation by getting the amount of atoms and multiplying them their atomic mass and then dividing that by the sum of all atomic masses multiplied with their respective amount

Commented [SD3]: (it can be difined as the solute's ability to dissolve in solvent)



Temperature has a direct relation with **solubility** and **dissolution** rate, surface area increase because matter expands when heated, leading to higher reaction rate, which leads to higher solubility and dissolution



Commented [SD4]: **Dissolution** is a process by which a solute dissolves into a solvent and forms a solution

it is like solubility but for the solvent rather than the solute

(2) Suspensions

They are heterogenous mixtures of udissolved particles, it's one of the 3 primary mixtures

The size of the particle of solute in the solvent is greater than 1000 nm, which can be seen by the naked eye

for example:

- Muddy water, where sand,clay,or soil partilcles are suspended in water without being dissolved, leading to the water looking muddy

- Rain, water droplets are suspended in air, but then they sediment and fall causing rainfall

Suspensions **are not stable**, because the suspended particles gradually sediment to the bottom of the solutions, that's why they can be filtered with physical means like gravity

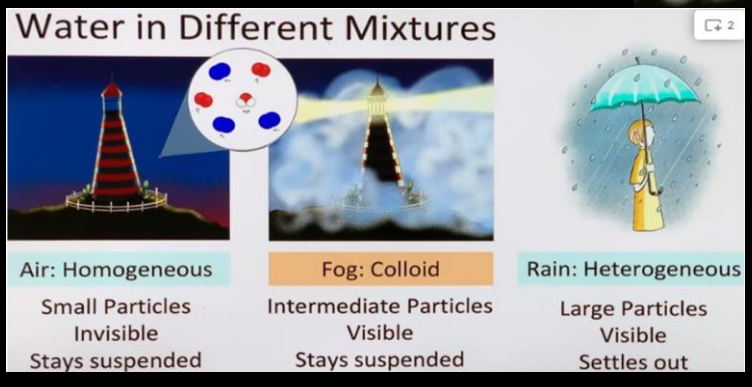
Particles in suspensions do not dissolve in the solute, they are just suspended in the bulk of it, and then they sediment

(3) Colloids

They fall between solutions and suspensions, where particles are too small to settle down, but they are too large to be seen

For example:

- Fog, where water droplets are suspended in air, they are too small for gravity to sediment them, but they are large enough to be seen by us



Back to **colloids**

The colloids, have two main parts called **phases**

the dispersed substance and **the dispersion medium**

for examlple: in fog, water is the **dispersed substance** while air is the **dispersion medium**

TYPES IF COLLOIDS

Aerosols

- Are when matter (whether it's liquid or solid) is dispersed in gas
- **For example**
  - Smoke
  - Aerosol sprays

Foam

- Are when gasses are dispersed inside matter (whether it's liquid or solid)
- **For example**
  - Whipped cream
  - Soap bubbles
  - styrofoam

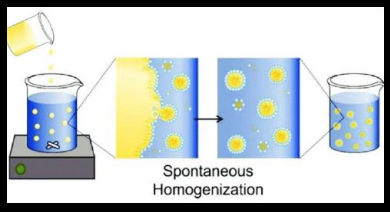
Gels

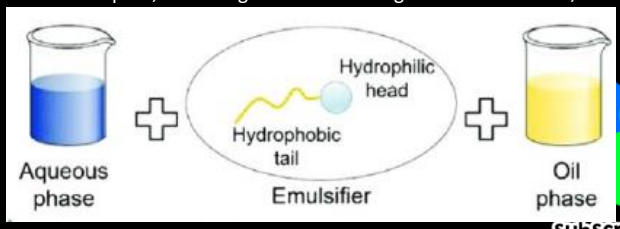
- when solids are dispersed inside liquid, giving them that extra viscosity
- **for example**
  - creams
  - jelly

Is the process of two immiscible liquids forming a colloid

Commented [SD5]: Liquids that do not form homogenous mixtures

Emulsifying agent is a substance that interacts between two liquids, stabilizing them and making them into a colloid, an example of this is soup with oil & water



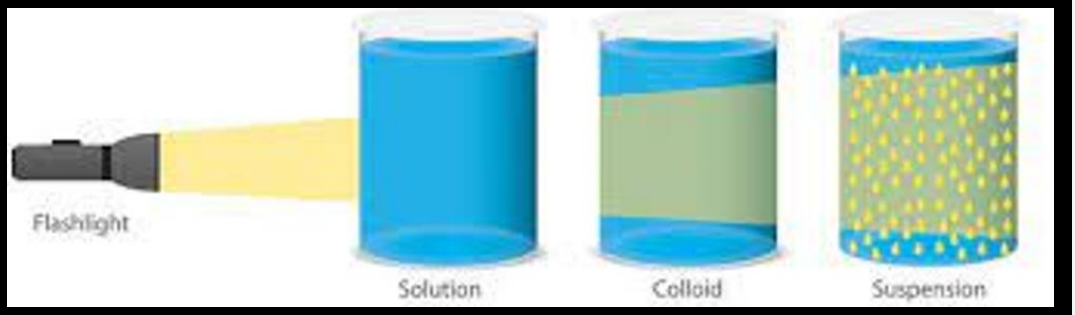


THE TYNDALL EFFECT

It's when light scatters differently depending on the type of mixture (solutions, colloids, suspensions)

It's used to differentiate between **colloids** and **solutions**

- solutions **don't scatter light** because the solute particles are too small to do that
- colloids scatter light because of their bigger particle size allowing them to do that
- suspensions scatter lights at very high rate because of their even bigger size than colloids

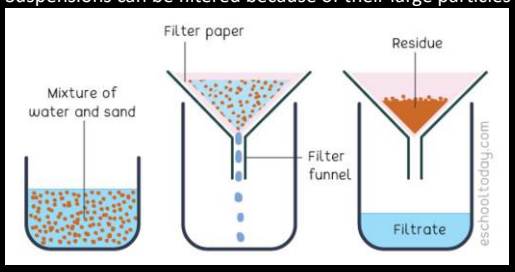


FILTERATION (the whole process)

It is seperating mixtures

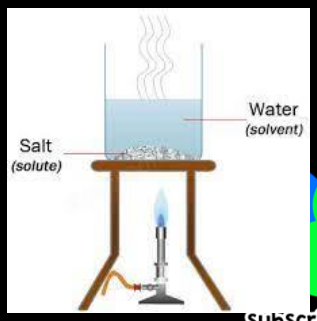
FILTRATION (the type)

- Is the process of removing solid particles from a mixture by pasing the mixture through a filter sheet (preferrebly made from cotton)
- Solutions and colloids cannot be filtered because of their small particles
- Suspensions can be filtered because of their large particles



Evaporation

- is the process of evaporating the liquid from a solution, leaving the solids behind, kind of like getting **salt** from a salt solution

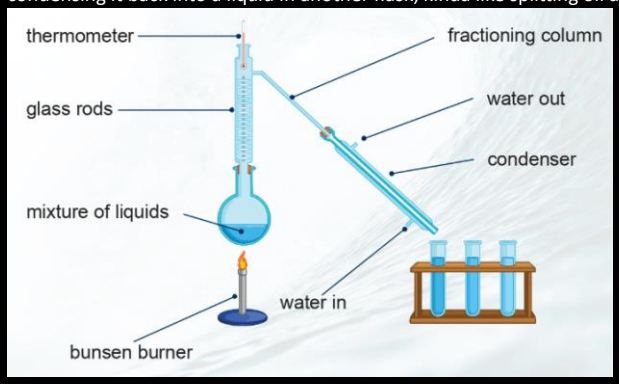


Commented [SD6]: Filtration is the whole process and a type at the same type
filtration is separating mixtures in general and it has many types like
distillation, evaporation, and **filtration**

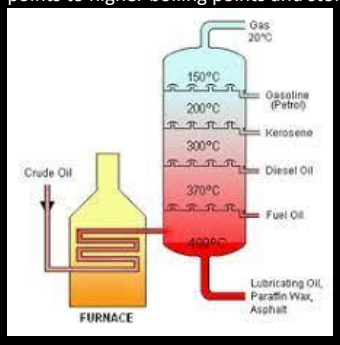
Here we are studying the type filtration
Which is filtering solid particles from a mixture by passing the mixture through a **filter sheet**

Disstilation

- is the process of splitting liquid mixtures, it has two types
  - **Simple disstillation**
    it works by splitting two liquids in a mixture by evaporating the one with lower boiling point then condensing it back into a liquid in another flask, kinda like splitting oil and water



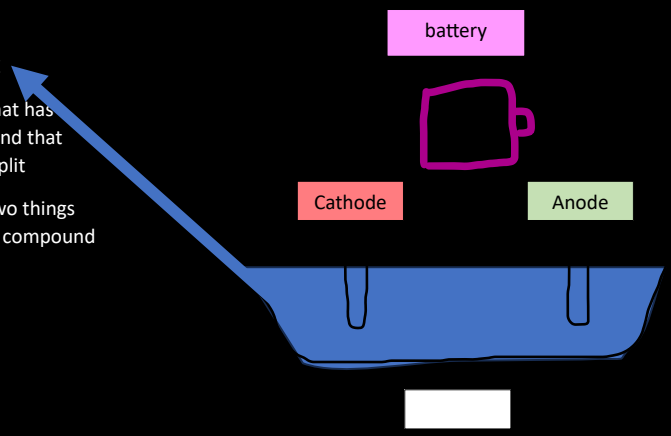
  - **Factorial distillation**
    it works by splitting multiple liquids in a mixture by evaporating->condensing liquids with lower boiling points to higher boiling points and storing in separate flasks/beakers, like splitting petrol



ELECTROLYSIS

It's splitting up ionic compounds with electricity

Every electrlysis experiment has the same main parts



THE ELECTROLYTE

It's the solution that has the ionic compound that you are going to split

It can be one of two things depending on the compound

- **IF IT IS SOLUBLE**
  - Then the compound will be dissolved in water creating an aqueous **solution,** that way the compound will split into freely moving ions across the water
- **IF IT IS INSOLUBLE**
  - Then the compound will be melted, that way the compound will split into freely moving ions

Commented [SD7]: Dissolved in water

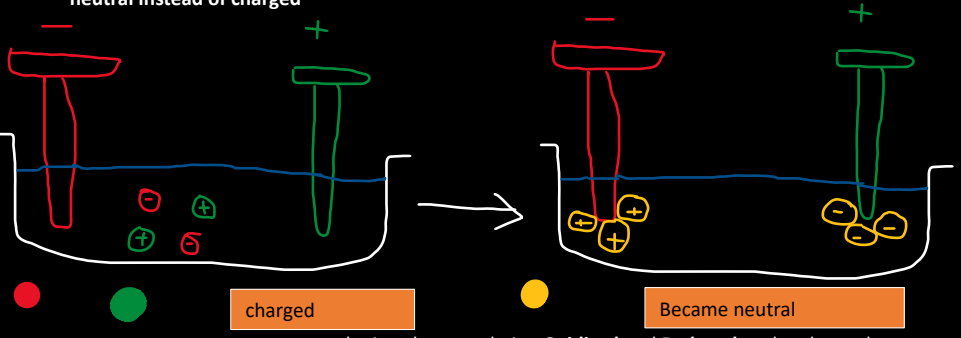
The reason we want freely moving ions, is that we need them to split a part, if they were bonded and not freely moving, the separating won't happen

How does electrolysis happen?

When an electric source is added like a battery, the cathode and anode become charged, the cathode is **negatively charged** and the anode is **positively charged**

the **positive ions** of the compound will **go t**o the **negatively charged cathode** and they will be **discharged** or **become neutral instead of charged**

the **negatively ions** of the compound will **go t**o the **positively charged anode** and they will be **discharged** or **become neutral instead of charged**



now the ions here are being **Oxidized** and **Reduced** to the electrodes

let's say we have **melted NaCl** as our ionic compound

the **chlorine negative ion** will be **oxidized** into normal chlorine, so the reaction will look like this

$Cl^- \rightarrow Cl + e^-$

So **oxidization** means losing electrons

the **sodium positive ion** will be **oxidized** into normal sodium, so the reaction will look like this

$Na^+ + e^- \rightarrow Na$

So **reduction** means gaining electrons

These two equations are **half-equations** for each part of the compound

The full equation for the NaCl ionic compound is written like this

$NaCl_{(l)} \rightarrow Na_{(l)} + Cl_{(g)}$

ELECTROLYSIS IN AQUEOUS SOLUTIONS

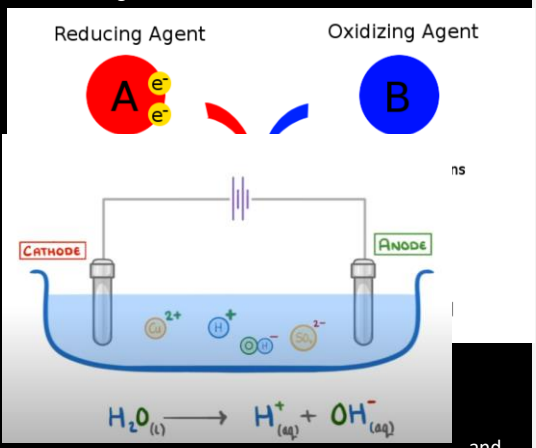
One of the hardest challenges in aqueous electrolysis is figuring out where ions go, let's imagine electrolysis in a **CuSO4 aqueous solution**, we would have positive copper ions and negative sulfate ions, but we will also have **positive hydrogen ions** and **negative hydroxide ions**

When the positive ions like **hydrogen** and **copper** go to the **cathode**, only 1 ion will be discharged

When the negative ions like **sulfate** and **hydroxide** go to the **anode**, only 1 ion will be discharged

To know who will be discharged, you need to know this

Halide means a compound that has group 17 in the periodic table, aka halogens like **Florine, chlorine, bromine, iodine**



Going back to our CuSO4 EXAMPLE

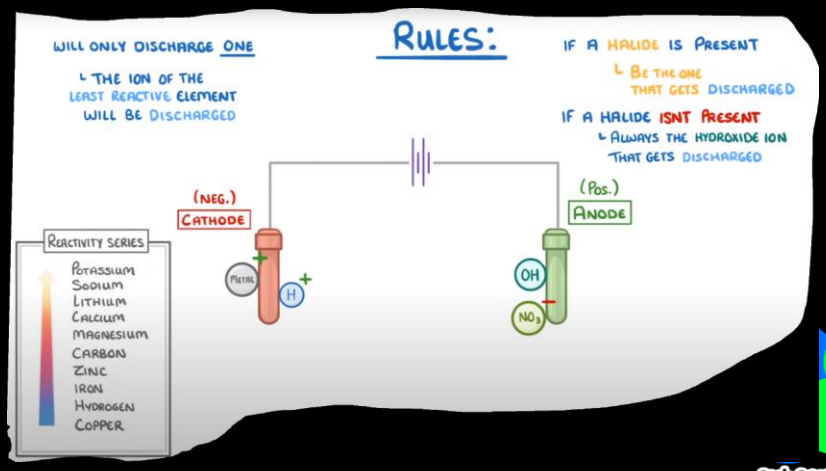
In the cathode, the copper atom will be discharged as it's less reactive than the hydrogen

In the anode, the hydroxide always wins when there is no halides so it will be the one that gets discharged, the **neutral hydroxide** will then **go on to form water and oxygen**

So we have a **neutral hydroxide** and a **neutral copper** atom, and a **sulfate ion** and a **hydrogen ion**

The equation for the hydroxide is

$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$



so here is how ions are neutralized by the electrodes

- negative ions go to the positive electrode to lose the extra electrons in a process called **oxidization**

- positive ions go the negative electrode to gain the extra electrons in a process called **reduction**

now here is the tricky part

positive ions that go through **reduction** are called **oxidizing agents**

negative ions that go through **oxidization** are called **reducing agents**