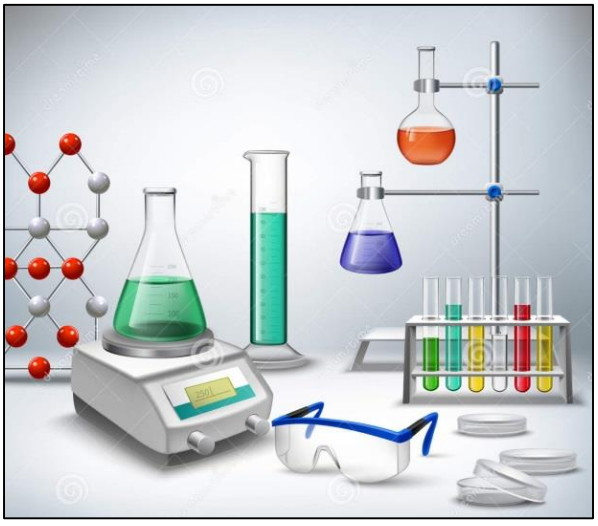
# St. Ninian's High School

# S1 Science



# Chemistry Notes

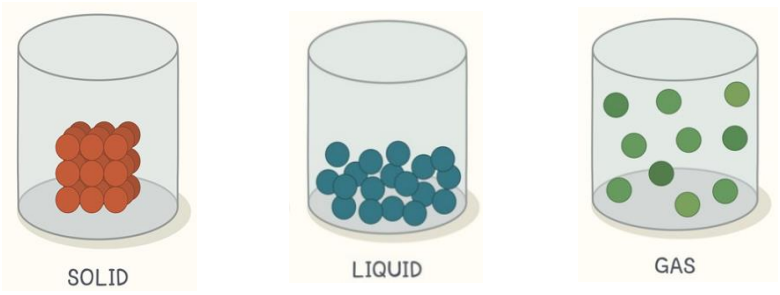
# Topic 1 - Matter

## Solids, Liquids and Gases

Everything in the world is either a solid, a liquid, or a gas. Scientists say that solids, liquids and gases are the three states of matter.

Scientists explain the properties of solids, liquids, and gases by talking about atoms. Atoms are like small balls. They are so small that if we placed 1,000,000,000 atoms end to end the line would be about 1 metre long.

**Arrangement of Particles**




**Solids**

The atoms in a **solid** are **packed closely together**. The atoms vibrate in place, they do not move from their rows that they are arranged in. This explains why solids have a constant shape and volume.

Example: Bricks

**Solids have a fixed shape and volume.**

**Liquids**

In a **liquid** we believe that the atoms are still **closely packed together, but that they are free to flow and roll over each other.** This explains why liquids can change their shape but cannot change their volume. When we pour liquid from a test tube into a beaker, the liquid flows and changes its shape to fit the shape of its container.

Example: Water
If we pour 50 $cm^3$ of water from a test tube to a beaker, it will still contain 50 $cm^3$ of water. Liquids change their shape depending on the container they are poured into.

**Liquids do not have a fixed shape but they do have a fixed volume.**

**Gases**

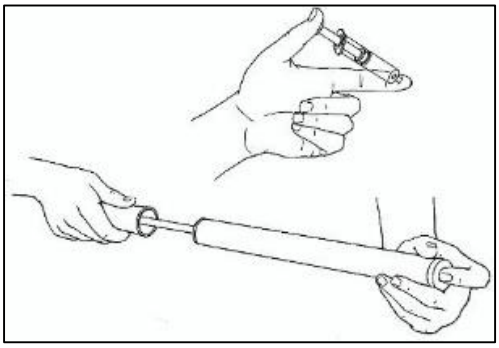
The atoms in a gas can move freely in three dimensions and there is a **lot of space between them**. They are only held together by the container the gas is kept in. The atoms are constantly moving, colliding with the walls of the container. This explains why gases have a variable shape and volume.

Example: Air

When we pour air from a test tube into a beaker, the gas flows and changes its shape to fit the shape of the beaker. Unlike liquids the gas can also change its volume.

**Gases can change their shape and their volume.**

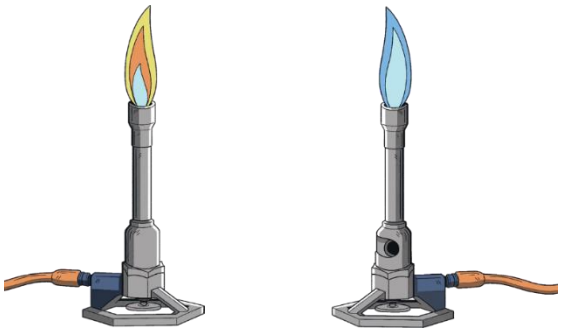
Solids, like the concrete this bridge is made from do not compress easily because their particles are close together.



Gases are easily compressed because of the large spaces between their particles.

## The Bunsen Burner

There 2 different flames on the Bunsen Burner - a yellow flame and a blue flame.



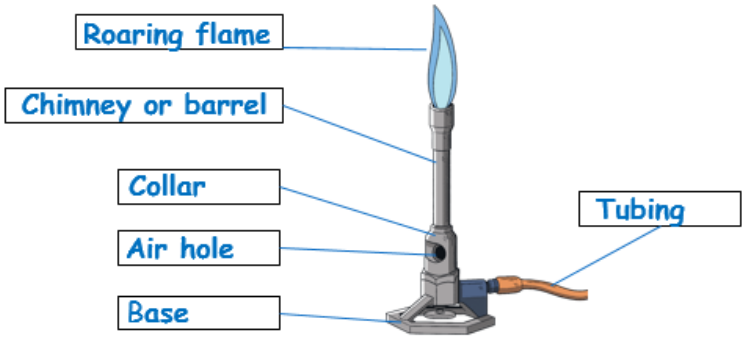
Safety Flame - air hole closed

Roaring Blue Flame - air hole fully open

The yellow flame is known as **the safety flame**. This flame can be seen easily when the Bunsen Burner is not in use.

The roaring blue flame is used for heating during experiments.

Below is a labelled diagram of the Bunsen Burner showing the different parts.




| | Colour of the Flame | Sound of the Flame | When Is It used? | Amount of Oxygen |
|---|---|---|---|---|
| Air Hole Open | blue | noisy /roaring | to heat things quickly | lots |
| Air Hole Half Open | blue | quite noisy | to heat things slowly | a little |
| Air Hole Fully Closed | yellow | quiet | for safety, when the Bunsen burner is not in use | very little |

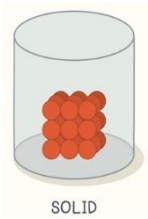
There are a number of other safety precautions we must take when using a Bunsen Burner. These include:

- stand up
- wear eye protection
- tie hair back
- put bags away
- tuck ties in

## Changes of State

### Melting and Boiling

When a solid is heated the heat energy is used to change the tightly packed solid particles into liquid particles. This occurs at the **melting point.** An example of this is when ice at 0°C is heated, it changes to liquid water.



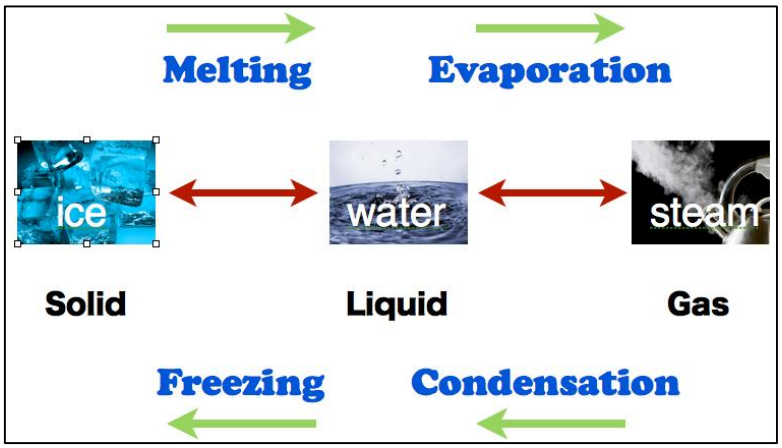

*Particles in a solid*


*Particles in a liquid*

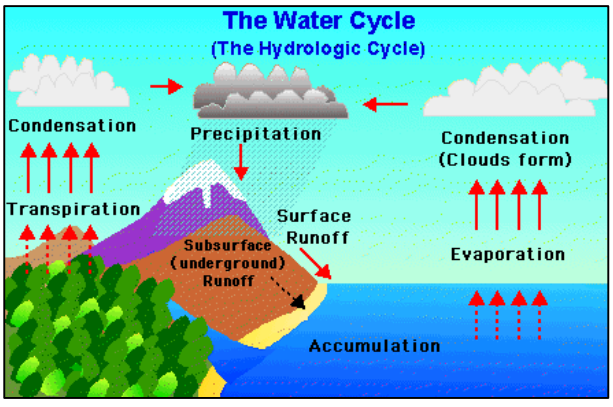
When a liquid is heated, the heat energy is used to change the liquid particles into free moving gas particles. This occurs at the **boiling point.** An example of this is when liquid water at 100°C turns into steam.

When we melt or boil a substance we do not increase the temperature, the added energy simply increases the particles' freedom to move.

The diagram below shows the names given to the changes when water, ice, and steam change from one state of matter to another.




These changes also happen in nature. An example of this is the water cycle which can be seen in the diagram below.

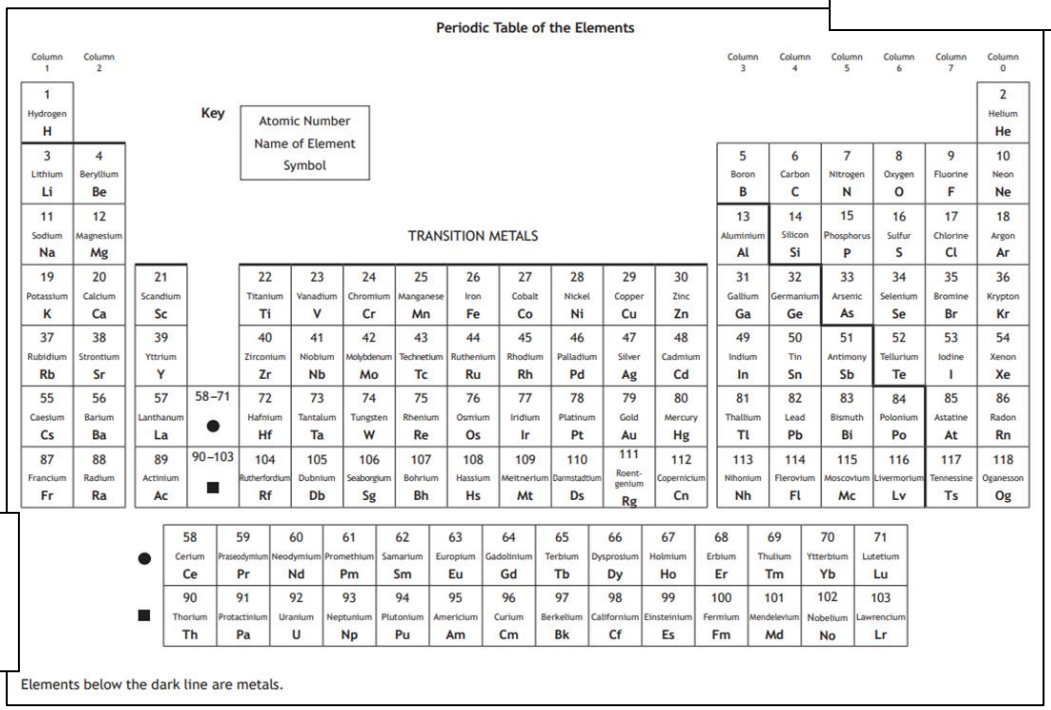


## Elements and the Periodic Table

Everything in the world is made up of substances called elements.

There are over 100 different elements that have been discovered. The elements are arranged in the Periodic Table.

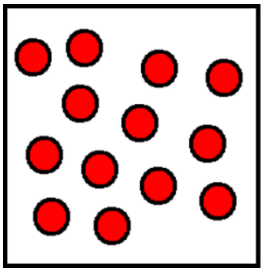
Non-metal elements are found in the top right hand corner

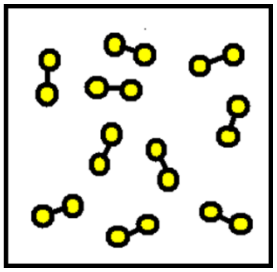



Metal elements are found below the dark line.

Each element has a **name, symbol and atomic number**. Atoms of different elements are different from each other. However, elements are made up of only one type of atom.

Elements can be represented by the particle diagrams below because the atoms in each one are all the same type.





If an element has a one letter symbol, it should be written as a capital letter and if it has two letters, the first should be a capital letter and the second lower case.

**Examples:** **Hydrogen = H** **Helium = He**

There are some elements which have symbols that do not match their names in English.

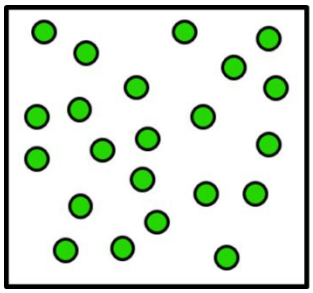
**Examples:** **Gold = Au** **Iron = Fe**

The elements get bigger depending on the particles that make them up. For example, carbon is an element found in all living things has an atomic number of 6, and has the symbol C. Iron is a metal used to makes bridges and building frames. It has the symbol Fe and has an atomic number of 26.

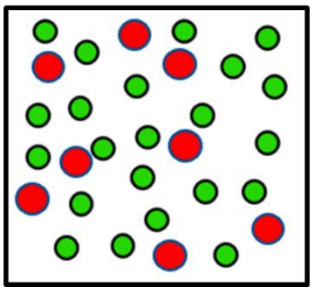
# Topic 2 – Substances

## Mixtures

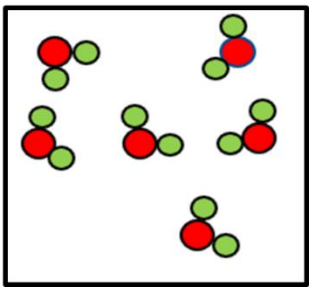
Mixtures of elements can undergo chemical reactions to form compounds. In a mixture, the atoms of the different elements are **not** joined together, but in a compound they are **chemically joined together**. Elements, mixtures and compounds can be represented by particle diagrams as shown below.



**Element** - all atoms are the same



**Mixture** - atoms are mixed but **not** chemically joined



**Compound** - atoms of different elements are chemically joined

## Making Solutions

If some salt is added to water and the mixture is shaken the salt disappears.

We say that the salt has dissolved in the water, to make a **solution**.

Substances which dissolve are said to be **soluble**. Substances which do not dissolve are said to be **insoluble.**

For example, **s**ugar dissolves in water. This means that it is soluble.

*Salty water solution*


Many things are solutions.

For example, Irn Bru contains flavourings, colourings and carbon dioxide which are all dissolved in water.

Nail varnish is **soluble** in propanone but **insoluble** in water.

## Separating Substances

There are a number of different techniques that can be used to separate substances from each other.

Some of these include:

1. Filtration

2. Evaporation

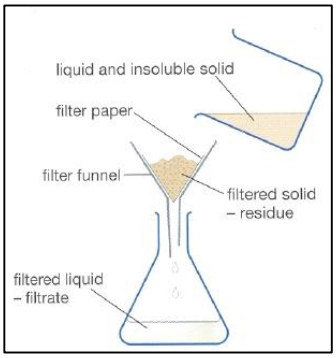
3. Chromatography

Mixtures can be easily separated because the atoms are **not chemically joined together.**

### Filtration

Filtration is a simple way of removing an insoluble substance from water.
The mixture is poured through filter paper and a funnel.

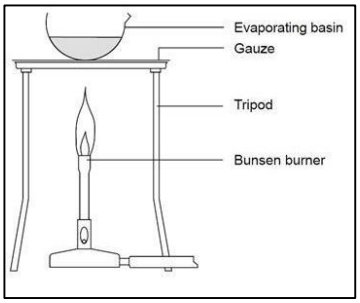
Insoluble substances are trapped in the filter paper, water and other dissolved substances pass through the paper into the beaker.




### Evaporation

Evaporation is a simple way of separating a soluble substance from water. The mixture is placed in an evaporating basin and heated.

The water boils and turns into steam leaving the dry sample of the solid in the basin.





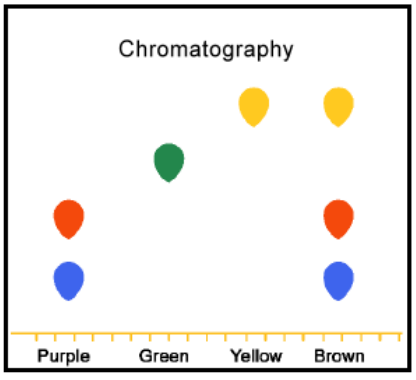
### Rock salt

Rock salt is a mixture of sand and salt which is obtained from mines, the sand and salt can be separated by:

1. Adding water, the salt is soluble, the sand is insoluble.
2. Filtering, this removes the insoluble sand from the salt solution.
3. Evaporating the salt solution, this removes the water and leaves the salt.

### Chromatography

Chromatography is used to separate dissolved substances from one another.
It is used when dissolved substances are coloured, e.g. inks, food colourings and plant dyes. It works because some of the coloured substances dissolve in the solvent used better than others, so they travel further up the paper.



# Topic 3 – Chemical Reactions

Table salt has the chemical name sodium chloride

## Making Compounds

Compounds are formed during chemical reactions. A chemical reaction occurs when **a new substance is formed.** The new substances have different properties to the elements that make them up.

For example, the compound sodium chloride is make up of sodium and chlorine. As elements, sodium reacts violently with water and chlorine is a poisonous gas. However, the compound sodium chloride is table salt that you would put on your food.

## Naming Compounds

The name of a compound tells us the elements present in that compound. Rust has the chemical name iron oxide. It contains the elements iron and oxygen.

Iron reacts with oxygen in the air to make iron oxide – commonly known as rust.

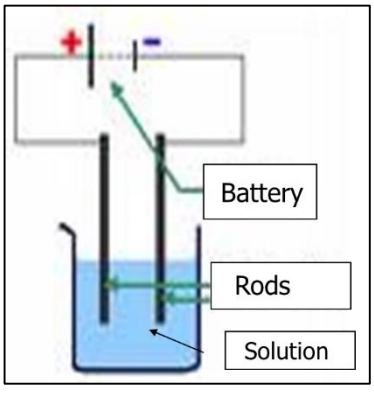
The bad smelling gas which comes from bad eggs is called hydrogen sulfide.
The name tells us that it contains hydrogen and sulfur.

By using the names of the elements we can create the name of the compound.

For example, potassium and bromine make the compound potassium bromide.

## Breaking Compounds

Compounds are difficult to break down because the atoms of the elements that make them up are chemically joined together. In order to break compounds we use **electrolysis**. Electrolysis is the process of breaking a compound using electricity.



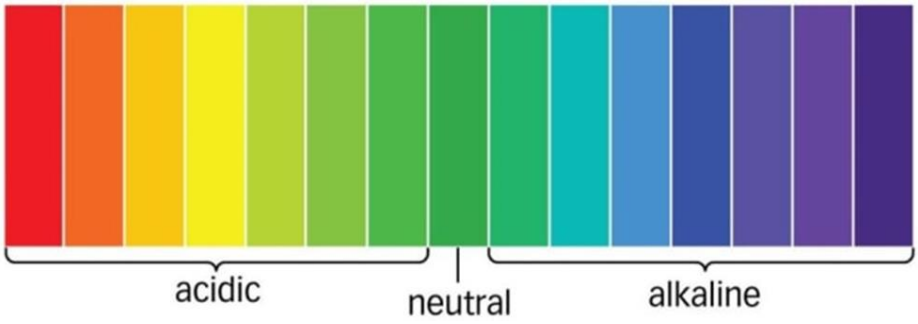


For example, we can use electrolysis to break the compound copper chloride. During this process, copper is formed at one of the rods and a brown solid can be seen, and chlorine is formed at the other rod where bubbles of gas are made as shown in the photo below.

## Introduction to the pH Scale

The pH scale can help up identify whether a substance is an acid, neutral or an alkali.

We add an indicator to a substance and this changes colour depending on whether it is acidic, neutral or alkaline. The colour can then be compared to the pH scale below.




## pH of Household Substances

The pH of some everyday household substances can be identified using indicator to test samples. The results are noted in the table below.

| Household Substance | Colour with indicator | pH | Acid/Neutral/Alkali |
|---|---|---|---|
| Vinegar | Orange | 3 | Acid |
| Fizzy juice | Orange | 3 | Acid |
| Lemon juice | Red | 2 | Acid |
| Bleach | Purple | 12 | Alkali |
| Soap | Blue | 9 | Alkali |
| Bicarbonate of soda | Blue | 8 | Alkali |

## Skills in Chemistry

### Table

The percent by mass of elements in the Earth's crust, oceans and atmosphere is represented by pie chart as follows:

| Element | Percentage (%) |
|---|---|
| Oxygen | 49 |
| Silicon | 27 |
| Aluminium | 8 |
| Calcium | 3 |
| Iron | 5 |
| Other elements | 8 |

Good tables have:

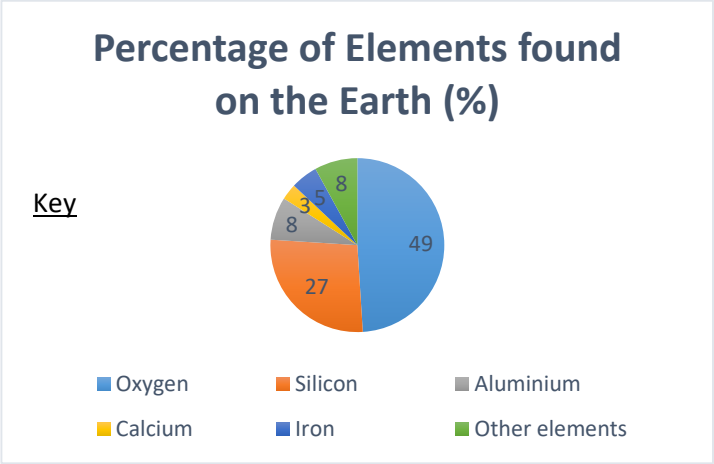
- Suitable titles with units
- Data entered under the correct heading.

### Pie Chart

The information in the table above can be represented by a pie chart as shown.

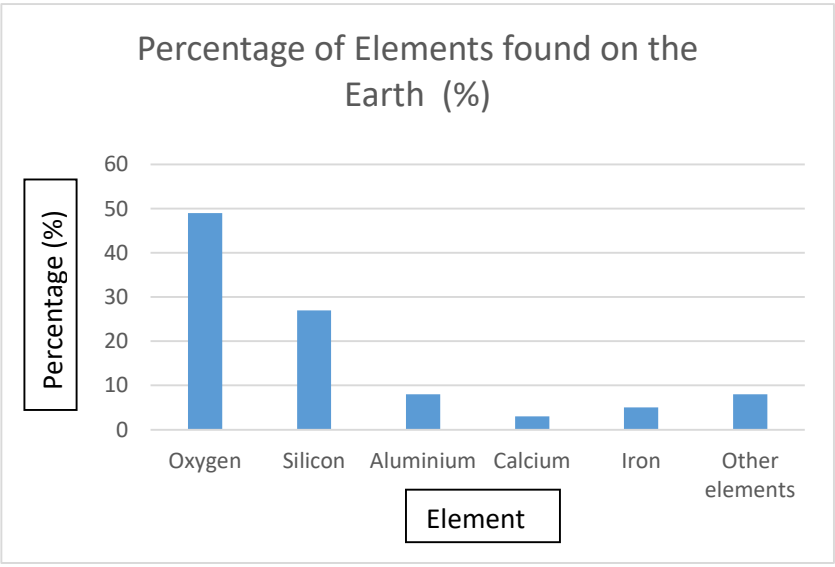
Good pie charts have:

- A key
- Sections of pie chart drawn neatly.




### Bar Chart

Another way of representing this information could be in a bar chart as shown below.




Good bar charts have:

- Axis labels (copied from the table).
- An even and equal scale (e.g. 0, 10, 20, 30 etc.)
- Bars drawn with straight lines using a ruler.
- Bars should have equal spaces between them.

# Topic 1 - Matter Learning Outcomes

- State that there are three states of matter; solids, liquids, and gases.
- State that solids have a constant shape and volume.
- State that liquids can change their shape to fit the container they are in, but that liquids cannot change their volume.
- State that gases can change their shape and volume to fit the container they are in.
- State that all things in the world are made of tiny particles called atoms
- State that the atoms in a solid are:
  a) tightly packed together with very little space between atoms
  b) arranged in a neat and regular way
  c) not able to move freely
- State that the atoms in a liquid are:
  a) tightly packed together with very little space between atoms
  b) free to move about within the liquid
- State that in a gas:
  a) atoms can move around freely in all directions
  b) there are large spaces between all the atoms
- Describe how to set up the safety flame and the roaring blue flame on the Bunsen Burner.
- State when the safety flame and the roaring blue flame should be used.
- State some safety precautions taken when using the Bunsen Burner.
- State that melting is the change from a solid to a liquid.
- State that freezing is the change from a liquid to a solid.
- State that evaporation is the change from a liquid to a gas.
- State that condensation is the change from a gas to a liquid.
- State that water freezes and ice melts at 0°C.
- State that water boils and steam condenses at 100°C.
- Identify the changes which happen in the water cycle as being evaporation, condensation, melting and freezing.
- State that everything in the world is made of small particles called atoms.
- State that there are over 100 substances called elements.
- State that all of the atoms in an element are the same.
- State that the atoms in different elements are not the same.
- State that all of the elements are arranged in the Periodic Table.
- State that all elements have their own name, symbol and atomic number.
- Identify particle diagrams that represent elements.

## Topic 2 - Substances Learning Outcomes

- State that the atoms in mixtures are not chemically joined together.
- State that a substance which dissolves in water is said to be soluble.
- State that a substance which does not dissolve in water is said to be insoluble.
- State that substances can be separated using different separating techniques such as:
  a) Filtration
  b) Evaporation
  c) Chromatography
- Describe what happens during filtration.
- Draw and label a diagram of filtration apparatus.
- State that filtration can separate an insoluble solid from a liquid.
- Describe what happens during evaporation.
- Draw and label a diagram of evaporation apparatus.
- State that evaporation can be used to separate a soluble solid from a liquid.
- State that chromatography can be used to separate dissolved substances from one another e.g. ink in pens.

## Topic 3 – Chemical Reactions Learning Outcomes

- State that the atoms in compounds are chemically joined together.
- State that compounds are formed during chemical reactions.
- State that during a chemical reaction a new substance is formed.
- State that the properties of compounds are different to the properties of the elements that make up the compound.
- Name compounds based on the elements that make them up.
- Name the elements that make up a compound based on its name.
- State that compounds are difficult to break because the atoms are chemically joined together.
- State that electrolysis is the process of breaking a compound using electricity.
- Describe what happens during electrolysis i.e. one element is formed at one electrode and the other element is formed at the other electrode.
- State that the pH scale can be used to identify if a substance is an acid, neutral or an alkali.
- State that an indicator changes colour when added to a substance that is acidic, neutral or alkaline.
- State some common household acids e.g. vinegar, fizzy juice, lemon
- State some common household alkalis e.g. soap, bleach, bicarbonate of soda