Planet Earth

Being a Chemist

Summary Sheets

Gleniffer High School

<u>Experiences & Outcomes</u>

By researching features of our solar system, I can use simple models to communicate my understanding of size, scale, time and relative motion within it.

SCN 2-06a

By using my knowledge of our solar system and the basic needs of living things, I can produce a reasoned argument on the likelihood of life existing elsewhere in the universe.

SCN 3-06a

Having explored the substances that make up Earth's surface, I can compare some of their characteristics and uses.

SCN 2-17a

Through evaluation of a range of data, I can describe the formation, characteristics and uses of soils, minerals and basic types of rocks.

SCN 3-17a

Having carried out a range of experiments using different chemicals, I can place metals in an order of reactivity, and relate my findings to their everyday uses

SCN 4-19b

I have collaborated in the design of an investigation into the effects of fertilisers on the growth of plants. I can express an informed view of the risks and benefits of their use.

SCN 2-03a

Through investigations and based on experimental evidence, I can explain the use of different types of chemicals in agriculture and their alternatives and can evaluate their potential impact on the world's food production

SCN 3-03a

State that the <u>light year</u> is a measure of astronomical distance

State the speed at which light travels

Give examples of the relative distance between the Earth and other celestial objects

By researching features of our solar system, I can use simple models to communicate my understanding of size, scale, time and relative motion within it.

SCN 2-06a

The Light Year

- The **light year** is a unit of astronomical distance
- It is the **distance** that light travels in **one year**.
- Light moves at a speed of about 300,000 km each second. So in one year, it can travel about 9.5 billion kilometres. A more precise number can be found using the calculation below.

Number of seconds in a year
= 60 x 60 x 24 x 365 = 31536000s

Distance	**=**	**Speed**	**x**	**Time**
1 light year	=	300000	x	31536000
	=	<u>**9460800000000km**</u>		

- We use the light year because distances to and from celestial objects are so great.
    - The Milky Way galaxy (the galaxy that contains our **solar system**) is about 150,000 light years across
    - The Andromeda Galaxy (the nearest galaxy to us) is 2.3 million light years away
- As the distances are so large, it is useful to use the time it takes light to reach us from celestial objects in order to get an idea of the scale of the universe and our position within it.

Source	Time taken for light to reach us on Earth
Moon	1.2 seconds
Sun	8 minutes
Nearest star	4.3 years
Other side of our galaxy	100,000 years
Andromeda galaxy	2,200,000 years

- Space shuttles can only travel at just over a **thousandth** of the speed of light so for it would take 4000 years for us to reach our nearest star.

Pupils must be able to:

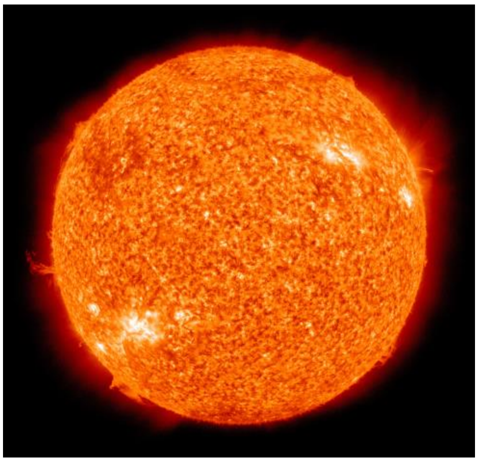
- state that the light year is a measure of astronomical distance
- state the speed at which light travels in space
- calculate how far a light year is
- give examples of the relative distances between the Earth and other celestial objects

By researching features of our solar system, I can use simple models to communicate my understanding of size, scale, time and relative motion within it.

SCN 2-06a

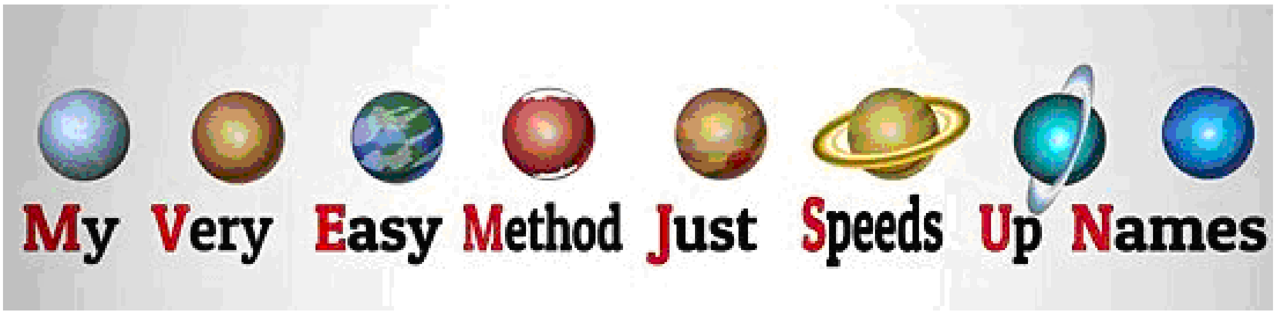
The Solar System

- Our sun is a **star** at the centre of our **solar system**
- It is a hot ball of gas, fuelled by nuclear reactions



- The sun gives emits light and heat (as well as other forms of radiation)
- A solar system is made up of all the objects that orbit a central star.
- In addition to planets, the solar system also consists of moons, comets, asteroids, minor planets, dust and gas.

- Everything in our solar system revolves around the Sun. The Sun contains around 98% of all the material in the solar system.
- The larger an objects is, the more gravity it has. Because the Sun is so large, its powerful gravity attracts all the other objects in the solar system towards it
- In turn, smaller objects such as moons orbit around larger planets
- The planets in our system (in order from the Sun) are:
  Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune



Pupils must be able to state:

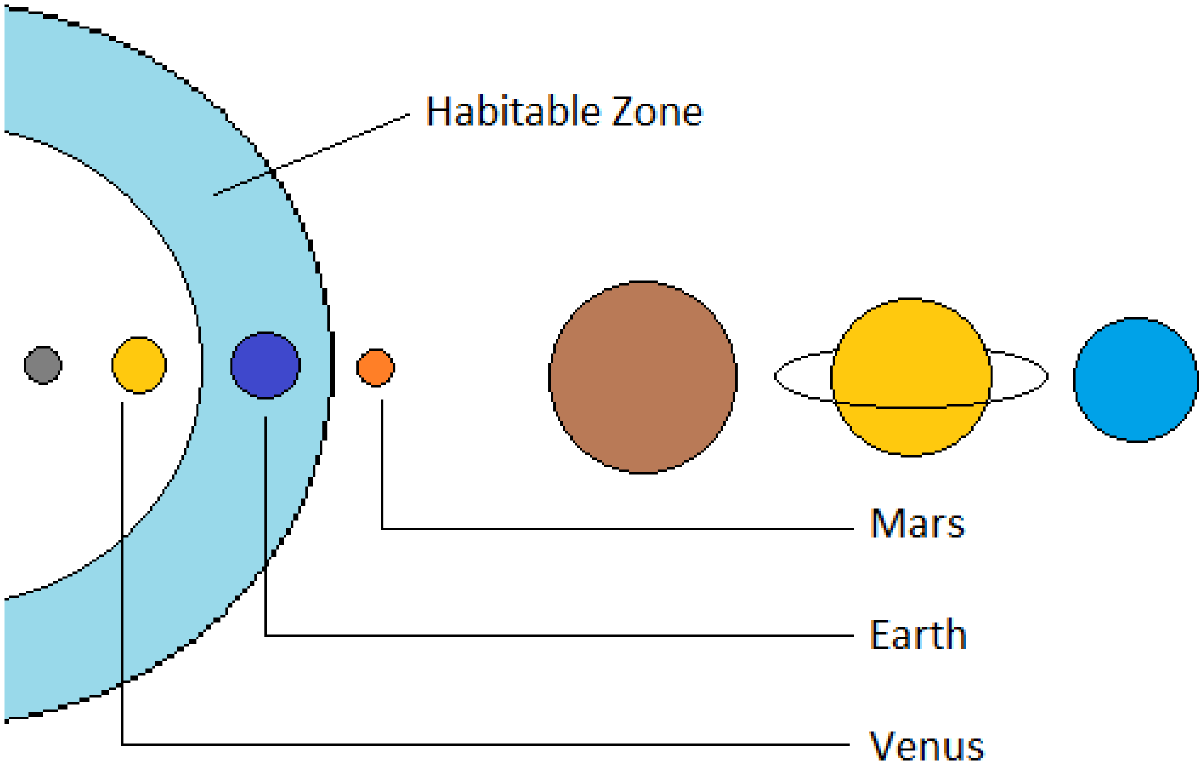
- the Sun is at the centre of our solar system
- the Earth is the third planet in our solar system
- the names of the planets in our solar system, in order from the Sun

By using my knowledge of our solar system and the basic needs of living things, I can produce a reasoned argument on the likelihood of life existing elsewhere in the universe.

SCN 3-06a

The Habitable Zone

- All life on Earth requires **liquid water** to survive
- The temperature of Earth is neither too hot nor too cold to allow liquid to form and so is **habitable**.
- The region on the solar system where the temperature allows for liquid water is called the **habitable zone**. The habitable zone is an area not too close or far away from the Sun allowing to neither be too hot or too cold. For this reason, the habitable zone is sometimes known as the '*Goldilocks Zone*'.
- Somewhere between 1.75 billion and 3.25 billion years from now, Earth will travel out of the solar system's habitable some and into the '*hot zone*' where liquid water will not be able to exist.



- It is thought that Mars once existed within the habitable zone and so may have once sustained life.

- Even now, scientists believe that if we were to live on another planet, Mars would be the best option. **Why do you think that is?**

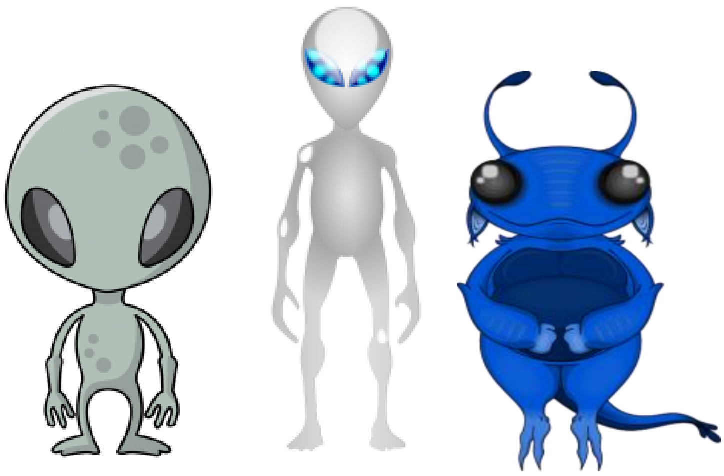
- There are however, many barriers to travelling to and living on Mars.

Life beyond Earth?

Questions to think about:

- What would a planet require in order to sustain life?

- What would life look like on a planet with different weather, gravity or atmosphere?



- What is the likelihood of life on other planets and if there was, how would we know?

Pupils must be able to:

- describe what is meant by the term 'habitable zone'
- state the conditions required on a planet in order for it to sustain life
- give a reasoned argument as to the likelihood of life on other planets

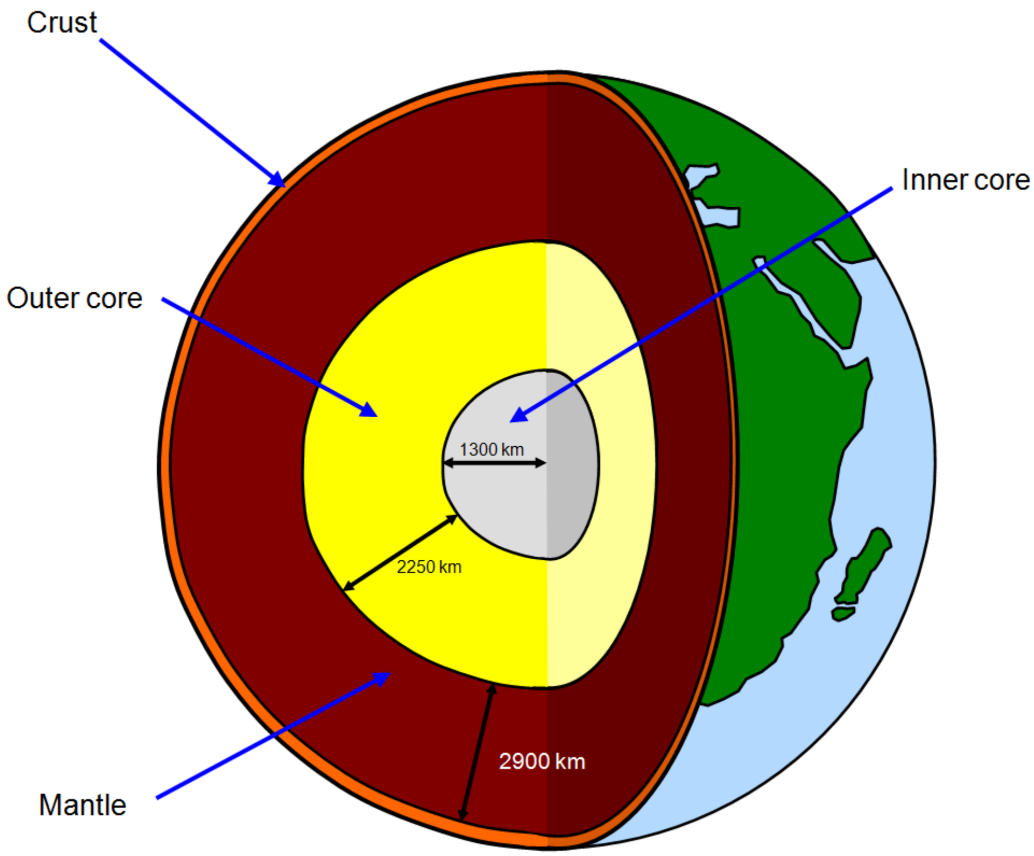
Having explored the substances that make up Earth's surface, I can compare some of their characteristics and uses.

SCN 2-17a

The Structure of the Earth

The Earth is made up of four distinct layers:

⇒ The **inner core**, the **outer core**, the **mantle** and the **crust**



- **The inner core** is in the centre and is the hottest part of the Earth. It is a **solid** and made up of **iron** and **nickel** with temperatures of up to 5,500°C. With its immense heat energy, the inner core is like the engine room of the Earth.

- **The outer core** is the layer surrounding the inner core. It is a **liquid** layer, also made up of iron and nickel. It is still extremely hot, with temperatures similar to the inner core.

- **The mantle** is the widest section of the Earth. It has a thickness of approximately 2,900 km. The mantle is made up of semi-molten rock called **magma**. In the upper parts of the mantle the rock is hard, but lower down the rock is soft and beginning to melt.

- **The crust** is the outer layer of the Earth. It is a thin layer between 0-60 km thick. The crust is the **solid** layer upon which we live.

Pupils must be able to:

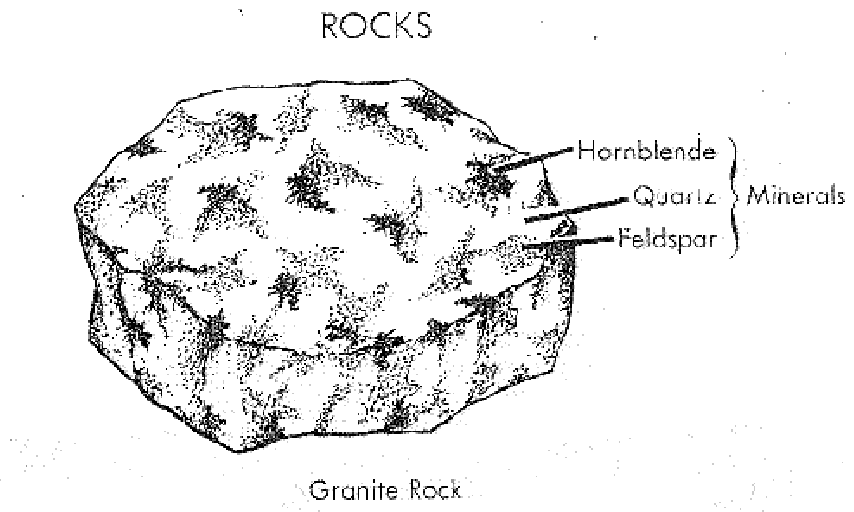
- describe the structure of the Earth using the terms crust, mantle inner core and outer core

Through evaluation of a range of data, I can describe the formation, characteristics and uses of soils, minerals and basic types of rocks.

SCN 3-17a

Rocks

- The Earth's crust contains hundreds of different types of rock. Rocks can be different colours, shapes and sizes. Some are hard whiles others are soft, some are heavy, and others are light.



- Rocks are essentially made of **grains** and **crystals** that fit together. Each grain in the rock is made from a mineral (chemical compound) and it is the structure and type of minerals in rocks that gives them their **properties**.

Recognising Rocks

- **Granite** is a very **hard** rock. It is **not easily scratched**. It has **crystals** that gleam in the sunshine. Some of the crystals can be seen by the naked eye

- **Chalk** is a **soft** rock. When **rubbed**, **grains** come off.

- **Slate** is a **hard** rock, but not as hard as granite. It contains **layers** of **crystals**.

- **Marble** is **hard** but is easily scratched. It is mostly white or grey in colour and can be streaky. It as **small crystals**.

- **Sandstone** is a **softer** rock made of **grains of sand**. The grains can be rubbed off with finger nails.

Types of Rock

There are three main types of rock:

⇒ **Igneous, sedimentary** and **metamorphic**

- **Igneous** rocks are formed when **magma** from deep beneath the Earth's surface cooled and hardened. Magma is liquid found beneath the Earth's surface which is very hot. Magma rises above the surface through the eruption of a **volcano**. Once above the surface of the Earth we often call the magma **lava**. The lava becomes **solid** when cooled. Igneous rocks can be easily distinguished as a result of their crystals, formed when the magma cools. The **longer** the magma takes the cool, the **larger** the crystals. Examples of igneous rocks are **granite** and **basalt**.

- **Sedimentary** rocks are formed when fragments of existing rocks (sediment) are broken off by weathering (**erosion**), carried in rivers to the sea where they sink to the bottom and **squeeze together** in **layers** to form new rock. Examples of sedimentary rocks are **sandstone** and **limestone**.

- **Metamorphic** rocks from when **heat** and **pressure** cause changes to existing rocks. Examples of metamorphic rocks are **quartzite, marble** and **anthricite**

Uses of Rocks

Granite is used in many buildings due to its hardness. **Aberdeen** is called the 'Granite City' and if you look closely, you can see the crystals in the stone many buildings are made of.

The Old Man of Hoy, a famous landmark in **Orkney**, is made of **sandstone**.

Edinburgh Castle stands one the top of a high rock made from **basalt**.

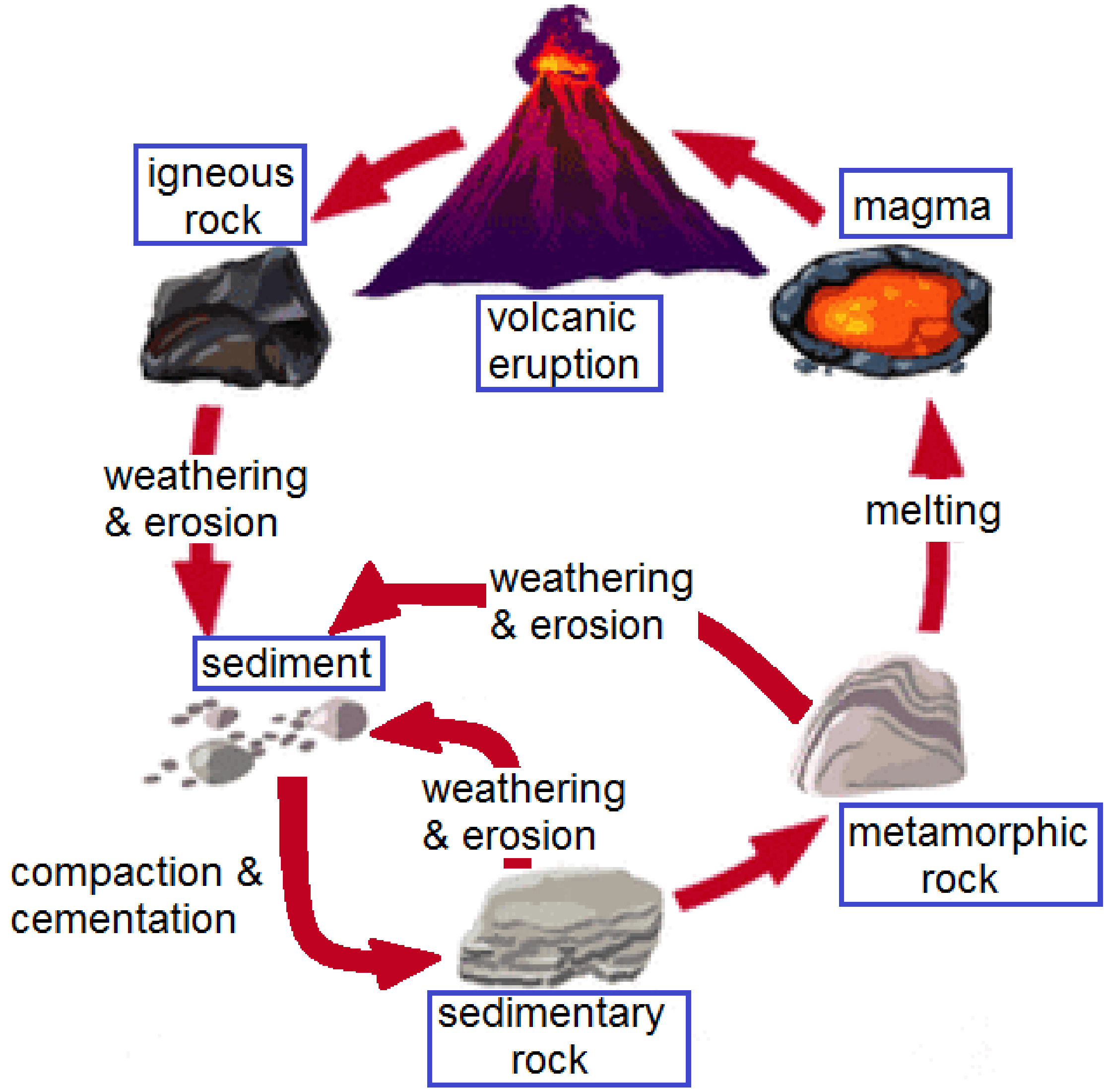
Pupils must be able to:

- state that Igneous rocks are formed from molten material
- state that Sedimentary rocks are formed from layers of sediment
- state that Metamorphic rocks are changed forms of sedimentary and igneous rocks
- describe how different types of rock (Igneous, Sedimentary and Metamorphic) are formed naturally

Through evaluation of a range of data, I can describe the formation, characteristics and uses of soils, minerals and basic types of rocks.

SCN 3-17a

The Rock Cycle



- **Sedimentation** creates layers of rock particles
- **Compaction** and cementation presses the layers and sticks the particles together. This creates **sedimentary rock**.

- Rocks underground that get heated and put under pressure are changed into **metamorphic rock**.

- Rock underground that gets heated so much they melt turn into **magma**. Magma is liquid rock. Magma also comes from deeper inside the Earth, from a region called the mantle.

- **Pressure** can force magma out of the ground. This creates a **volcano**. When magma cools it turns into solid rock, called **extrusive igneous rock**.

- Magma that cools underground forms solid rock called **intrusive igneous rock**.

- Areas of rock can move slowly upwards, pushed up by the pressure of the rocks forming underneath. This is called **uplift**.

- **Weathering** breaks down rocks on the surface of the Earth. There are three types of weathering – physical, chemical and biological.

- **Wind** and **water** move the broken rock particles away. This is called **erosion**.

- Rivers and streams **transport** rock particles to other places,
- Rock particles are **deposited** in lakes and seas, where they build up to form layers. This starts the process of **sedimentation** which will create **sedimentary rock**.

Pupils must be able to:

- describe the rock cycle and give an example of a type of rock at each stage,

Through evaluation of a range of data, I can describe the formation, characteristics and uses of soils, minerals and basic types of rocks.

SCN 3-17a

- Granite, sandstone and slate are used as building materials.



- Marble is used to make statues because it is hard and attractive due to its crystals.

- Sandstone is very strong and resistant to acid attack. It makes it suitable as a building material.

- It is also unaffected by high temperatures making it suitable for fireplaces.

Pupils must be able to:

- state uses for different types of rock

I have developed my knowledge of the Periodic Table by considering the properties and uses of a variety of elements relative to their positions.

SCN 3-15a

Having contributed to a variety of practical activities to make and break down compounds, I can describe examples of how the properties of compounds are different from their constituent elements.

SCN 3-15b

Metals

- Metals have many uses on our planet.
- **Aluminium** is lightweight and used to make planes
- **Steel** is heavier but very strong and used in the construction of buildings and bridges
- **Copper** is an excellent conductor of heat and used in pots and pans as well as being an excellent conductor of electricity making it suitable for electrical cables.

- Some metals such as **gold** and **silver** can be found by simply digging into the ground. They exist as elements as they are very **un-reactive**.

- Many metals such as copper and iron are **extracted** from **compounds** found in rocks called **ores**.

- Metals that are very **reactive** exist as ores as they are too reactive to exist as a pure element e.g. **iron** often exists as **iron oxide** which is a compound.

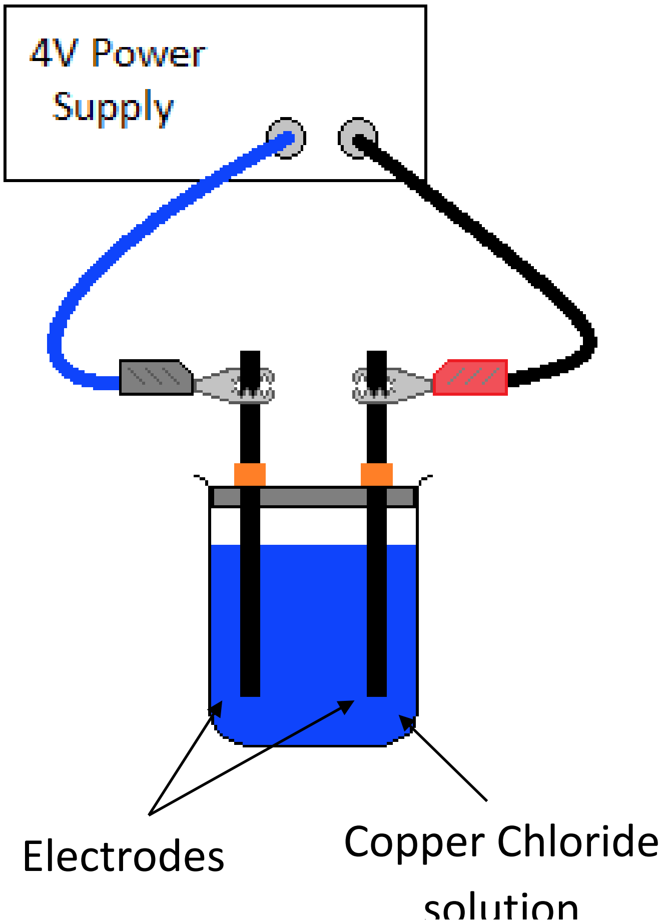
- Such compounds in ores, need to be separated in order to obtain the metal elements, other are made from compounds found in sea water.

Extracting Metals

- Some compounds can be separated by **heating** them alone; others need to be heated with carbon. This **displaces** the metal from the oxygen forming the metal element and carbon dioxide e.g.

copper oxide + carbon → copper + carbon dioxide

- Others can be separated using **electrolysis**, where electrical energy is used to split a compound in solution.



Pupils must be able to:

- state uses for different metals
- state what is meant by an ore in terms of elements and compounds
- describe how metal compounds in solution can be separated by electrolysis
- state that some metals can be extracted from their metal oxides by heat alone, some must be heated with carbon

Having carried out a range of experiments using different chemicals, I can place metals in an order of reactivity, and relate my findings to their everyday uses

SCN 4-19b

Reactivity series

- Some metals are more reactive than others.
- The **reactivity series** is a kind of league table of metals, putting metals in order of reactivity.

Most reactive

Potassium
Sodium
Lithium
Calcium
Magnesium
Aluminium
Zinc
Iron
Tin
Lead
Copper
Mercury
Silver
Gold

These are the MAZIT metals. They can be used to easily remember the reactivity of some of the more commonly used elements

Least reactive

- Potassium is at the tope of the reactivity series. It reacts quickly with water and explodes when put into acid.

- Silver and gold are at the bottom of the reactivity series because they are un-reactive.

- Un-reactive metals are very useful. For example, gold is used to make jewellery because it does not corrode (rust) and it is very shiny. It also doesn't react with air or water.

- Copper is used in plumbing because it doesn't react with water.

Reactivity of metals in air

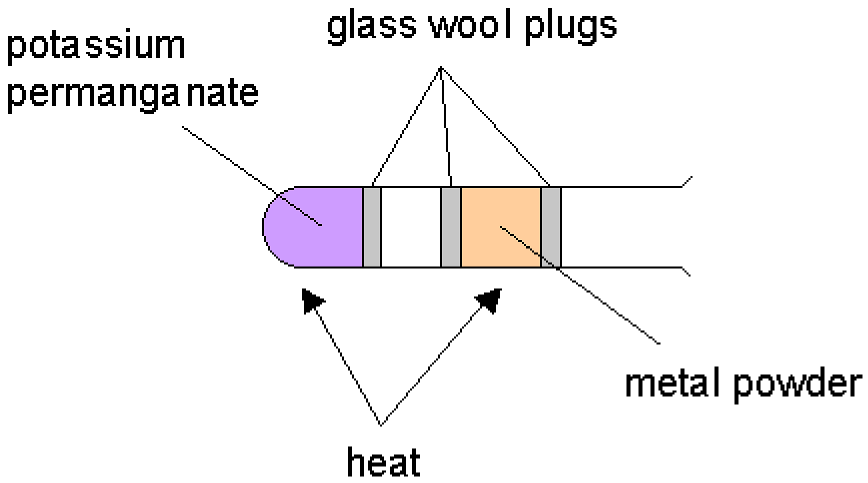
- Oxygen is a highly reactive gas which forms compounds with many elements.

- When a piece of magnesium is heated in air, the magnesium reacts with the oxygen in the air to form the compound magnesium oxide

  magnesium + oxygen → magnesium oxide

Reactivity of metals in oxygen

- Metals can be heated in oxygen to find out how reactive they are.



- Copper is an element that exists as an **ore**. It turns green when exposed to air and water.

- This can be seen on the many buildings for example the copper roof of the Mitchell Library in Glasgow which has a copper dome.

Reactivity of metals in water

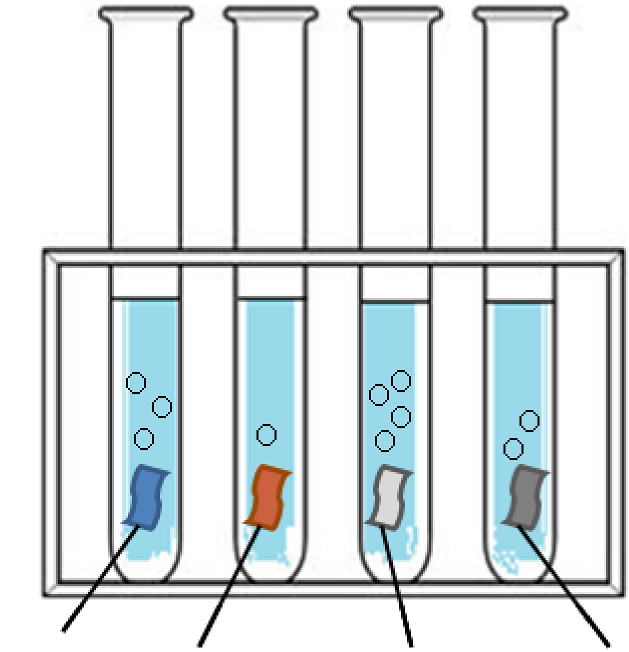
- The **alkali** metals in the periodic table react with water.

- The produce hydrogen gas and an alkali.

e.g. sodium and water reacts to produce the alkali sodium hydroxide and hydrogen

sodium + water → sodium hydroxide + hydrogen

Reactivity of metals in acid



Reacting metals with acid helps us come up with an order of reactivity for metals which do not react with water.

- Metals that react with acid produce hydrogen gas and a salt

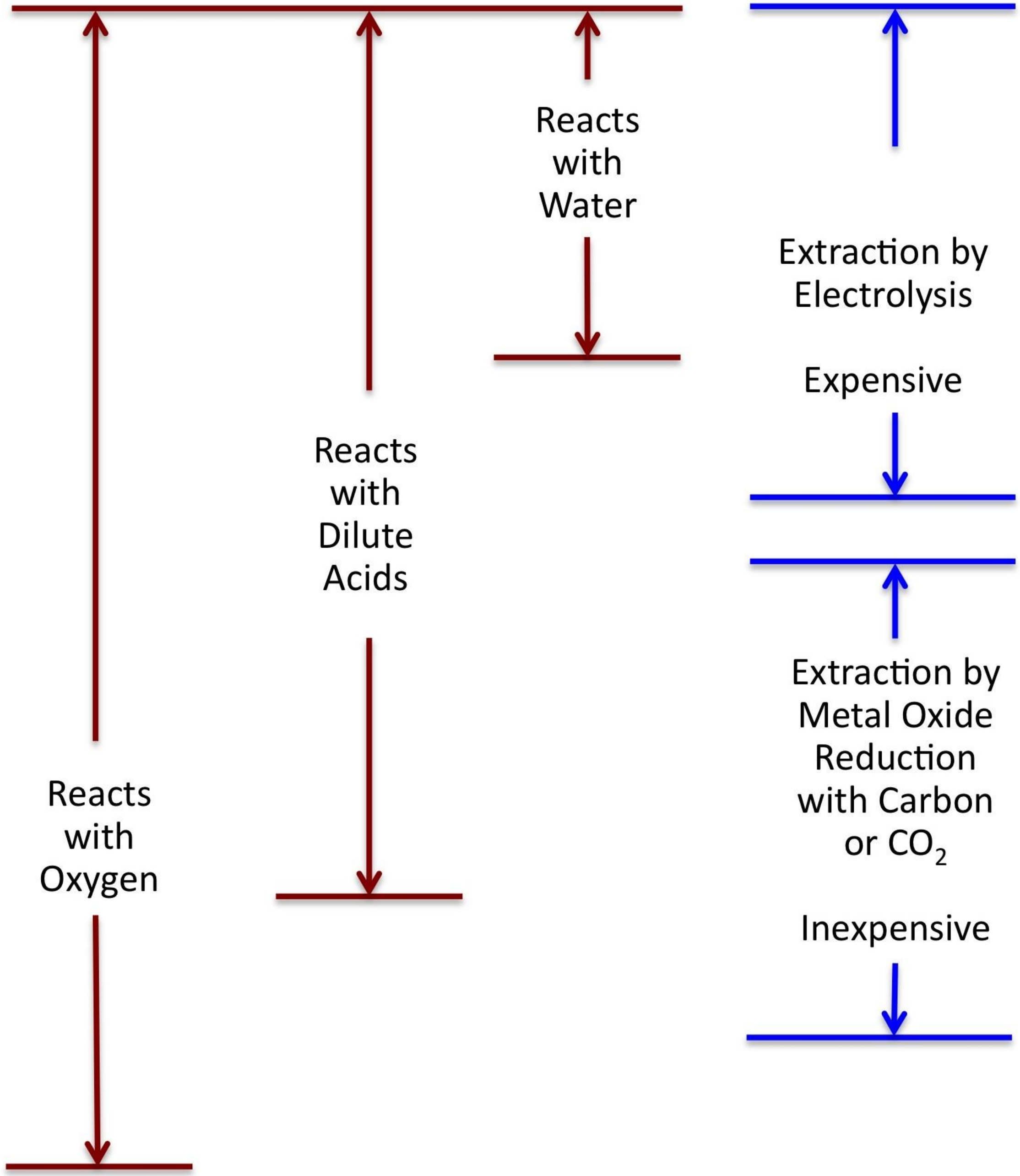
e.g. magnesium reacts with hydrochloric acid to form the salt magnesium chloride and hydrogen

magnesium + hydrochloric acid → magnesium chloride + hydrogen

Very Reactive

Li	*Lithium*
K	*Potassium*
Ba	*Barium*
Ca	*Calcium*
Na	*Sodium*
Mg	*Magnesium*
Al	*Aluminum*
C	*Carbon*
Zn	*Zinc*
Fe	*Iron*
Ni	*Nickel*
Sn	*Tin*
Pb	*Lead*
H	*Hydrogen*
Cu	*Copper*
Hg	*Mercury*
Ag	*Silver*
Au	*Gold*
Pt	*Platinum*

Very Unreactive



Carbon and Hydrogen are not metals but are included for reference.

Pupils must be able to:

- State the reactivity series of metals based on experimental observations

Through evaluation of a range of data, I can describe the formation, characteristics and uses of soils, minerals and basic types of rock

SCN 3-17a

Soils

- When rocks are worn away by chemical weathering (rain, acid rain, wind and sunshine) tiny grains become broken off. These grains make up much of our **soil**.

- When water enters cracks in the rock, the rock freezes and expands, breaking up the rock and turning it into soil

- Soil also contains **water** and **air.**

- Soils can be very different depending on the area they are from

- **Clay soils** are made from tiny grains stuck together. They have few air spaces and have water trapped between the grains.

- **Sandy soils** are made up of bigger grains with larger spaces between the grains. Water can pass between the grains. Sandy soils are light and easily **drained**.

- **Loam soils** contain clay, sand and lots of humus (organic matter, e.g. compost)

- Loam soils are generally considered to be the best soils; however different plants prefer different growing conditions.

Pupils must be able to state that:

- **soil is comprised of rock grains, water, air and humus**
- **there are different types of soil including clay and sandy**
- **the best soils contain some clay, some sand and lots of humus**

I have collaborated in the design of an investigation into the effects of fertilisers on the growth of plants. I can express an informed view of the risks and benefits of their use.

SCN 2-03a

Through investigations and based on experimental evidence, I can explain the use of different types of chemicals in agriculture and their alternatives and can evaluate their potential impact on the world's food production

SCN 3-03a

Chemical plants need to grow

- Plants make their own food using two chemicals: water and carbon dioxide
- Plants need other chemicals to survive
- Three of these are called the **essential elements**: **nitrogen (N), phosphorous (P) and potassium (K)**, commonly known as **NPK**.
- Plants usually obtain these essential elements in the form of soluble compounds, dissolved in the water taken up through roots

- Leguminous plants contain friendly bacteria which get nitrogen through their nodules – they are called nitrogen fixing bacteria.

Fertilisers

- Fertilisers are used by farmers to replace the elements which have been taken in by the plants. There are three main types of natural fertilizer: compost, animal manure and plant manure.

- **Compost** is made by rotting plant material such as leaves and unwanted fruit and vegetables. The waste is piled up in a compost heap and bacteria, fungi and insects living in the compost use oxygen to break down the waste to form humus. The humus contains all the essential elements required by plants

- **Manure – animal** is mainly faeces (animal waste, human sewage and bird droppings) and materials such as straw.
  Human sewage is normally deposited straight into the soil to reduce the smell.
  Manure can ignite spontaneously due to the methane gas content.

- **Manure – plant** is known as green manure. It is usually a leguminous plant which grows quickly. It is then ploughed back into the soil. Such plants, when they rot, release the nitrogen which they have fixed as a soluble compound back into the soil.

Artificial Fertilisers

- Due to high demand as our population increases and we have more mouths to feed, many farmers use artificial fertilizers.

- They are mixtures of soluble compounds containing the essential elements

- The compounds must dissolve in water so that they can be taken through the plant's roots

- However is an artificial fertilizer is too soluble, it will wash away into rivers causing algae blooms

Pupils must be able to state that:

- **Plants need the chemicals nitrogen, phosphorus and potassium (NPK) in order to survive**
- **Fertilisers can be used to get these chemical to the plants.**
- **Fertilisers can be natural e.g. compost or artificial**