**Course Structure in S2 Science**

S2 learners will follow three 5 week rotations (Biology, Chemistry and Physics) prior to Christmas. During this time learners will be involved in a range of activities designed to help them explore the outcomes below.

Learners will have the opportunity to sit either 1 problem solving tests (no studying required as this is skills based) or either 1 investigation relating to the topic. They will all sit an end of topic test. Learners should be encouraged to study regularly in preparation for the end of topic test which will occur in week 5 of any rotation.

Towards Christmas learners will have an S2 exam. This covers all core knowledge listed below in rotation 1.

After Christmas learners will study 3 further rotations in each of the sciences in preparation for S3 and will compete in the Waid Academy Climate Challenge.

**Rotation 1 (before Christmas)**

**S2 Biology**

SCN I have contributed to investigations into the different types of micro organisms and can explain how their growth can be controlled.

* Identify three different types of microorganisms – bacteria, viruses & fungi
* Give examples of each of the three types
* State that some microorganisms can be useful and some can be disease causing and give examples
* Explain how the growth of microorganisms can be controlled
* describe the precautions that should be taken when working with microbes and explain their importance
* carry out a practical involving sampling and/or growing microbes
* list the basic requirements for microbial growth

**Defence**

* State the ways that microbes can enter the body

**First line of defence**

* Describe defence mechanisms of the body including: skin, tears, stomach acid & white blood cells

**Second line of defence**

* State that white blood cells destroy invading microbes

Learners need to be able to:

* State that the body’s 2nd line of defence is the immune system
* Say that white blood cells play an important role in secondary defence
* Name phagocytosis as a method carried out by white blood cells of destroying invading microbes
* State that white blood cells produce antitoxins to neutralise chemicals produced by invading bacteria
* Name the type of white blood cells which produce antibodies as lymphocytes

**Acquired immunity**

**Vaccines**

* State that vaccination is a method of acquiring immunity against certain diseases
* Explain what is contained in a vaccine

Learners need to be able to:

* Describe how antitoxins work
* Describe how phagocytosis destroys invading microbes
* Describe how antibodies destroy invading microbes
* Explain how vaccines work

**SCN I have explored the role of technology in monitoring health and improving the quality of life 3-12b**

* Name technology used to monitor temperature, heart rate, blood pressure, peak flow & body fat
* Identify advantages and disadvantages for both types of technology
* Explain how monitoring aspects of health can improve quality of life

**S2 Chemistry**

**Properties of Acids and Alkalis**

* Acids and alkalis are used in the home, industry and school
* Common household acids are vinegar, lemonade, soda water and coca cola
* Common household alkalis are baking soda, oven cleaner, dishwashing powder, bleach and soaps
* Common laboratory acids are hydrochloric acid (HCl), sulphuric acid(H2SO4), nitric acid (HNO3)
* Common laboratory alkalis are, sodium hydroxide solution, lime water, ammonia solution

**The pH scale**

* The pH scale is used to measure the acidity or alkalinity of a chemical.
* A substance must be in a solution for its pH to be measured.
* Use pH paper, universal indicator or a pH meter to measure pH.
* Acids have a pH of less than 7.
* Pure water and neutral solutions have a pH of 7.
* Alkalis have a pH of more than 7.
* The lower the pH of an acid, the **greater** its acidity.
* A solution with a pH of 2 is more acid than a solution with pH 6.
* The **higher** the pH of an alkali, the greater its alkalinity.
* A solution with a pH of 14 is more alkaline than a solution with pH 10.
* As an acid solution is diluted, its acidity decreases and its pH increases.
* As an alkaline solution is diluted, its alkalinity decreases and its pH decreases.

**Neutralisation**

* When an acid reacts with an alkali the pH of both solutions moves towards 7.
* Water (pH 7) is produced in the reaction.
* Salt is also produced. Acids have a pH of less than 7; alkalis have a pH of more than 7.
* Acid + alkali raises the pH of the acid
* Alkali + acid lowers the pH of the alkali.
* Neutralisation moves the pH of an acid up towards 7.
* Neutralisation moves the pH of an alkali down towards 7.
* acid + alkali → salt + water
* acid + metal carbonate → salt + Carbon Dioxide
* acid + metal → salt + hydrogen
* Describe the significance of pH and neutralisation in everyday life

**Rates of Reaction**

* State three ways to increase the rate of a chemical reaction.

**S2 Physics**

Nature of forces

Learners need to be able to:

* State that when a force acts on an object the object may change its speed of movement, direction of movement or its shape.
* State that if all the forces on an object are balanced it will continue at the same speed in the same direction or stay at rest.
* State that magnetic, electrostatic and gravitational forces are all “forces at a distance”.
* Magnetic force:
	+ All magnets have both a north and a south pole
	+ Like poles repel and unlike poles attract
	+ Magnetic materials are attracted to magnets because they become temporary magnets.
* Electrostatic force:
	+ All objects contain roughly equal amounts of positive and negative charges.
	+ Like charges repel and unlike charges attract.
	+ When two objects rub together, some charges can be transferred from one object to another, making one positive and the other negative.
* Gravitational force:
	+ Is only ever attractive
	+ Much weaker than electrostatic and magnetic (given the size of the objects exerting the force)
* The unit of force is the newton (N).

Students may also be able to:

* Explain that charged objects attract neutral objects (e.g. charged rod picking up pieces of paper, deflecting water) because it rearranges the charges in the neutral object.

Mass and weight

Learners need to be able to:

* Explain the difference between mass and weight
* Calculate weight from mass
* Know the units of mass (kg) and the units of weight (N)
* Know that weight, like all force, can be measured using a newton balance.
* The gravitational field strength on a planet depends on the mass of the planet and how far you are from its centre.

Weightlessness and falling

Learners need to be able to:

* Explain true weightlessness by referring to the formula for weight with g = 0 in deep space.
* Explain how objects orbit the Earth by moving very fast horizontally so that as they fall the Earth curves away. They need to be in space so that there is no air resistance at these high speeds.
* Explain situations where an object may have apparent weightlessness eg. in a freefalling container like a satellite or a person in a lift.
* Explain that all objects freefall in the same way and that two objects dropped from the same height will hit the ground at the same time, (as long as air resistance is small compared to the weight).
* Explain that if objects have been falling a long way through air, the air resistance increases and becomes important. When air resistance becomes equal to weight, objects stop getting faster and hit a top speed (terminal velocity). Terminal velocities for high mass objects tend to be greater than for low mass objects.

Friction

Learners need to be able to:

* Explain that friction opposes motion
* Explain that there are two types of friction:
	+ Kinetic friction: when two objects are sliding past each other. This type of friction turns kinetic energy into heat.
	+ Static friction: if you try and push something sideways, the static friction will grow until it starts to move.
* State that the maximum static force of friction is greater than the kinetic force of friction.
* State methods of decreasing and increasing friction and relate to real-world situations.

In addition they may be able to:

* Explain that the static force of friction for a block sliding depends on the weight of the object and on the surfaces but not on the area/side of the block it is resting on.
* Explain that the kinetic force of friction for a block sliding depends on the weight and surfaces but not on the side the block is resting or on the speed.
* State that the laws of friction are not exact and must be found by experiment (empirical laws). Explain how to calculate the “friction number” using the friction force/weight.

**Rotation 2 (after Christmas)**

**S2 Biology**

Photosynthesis

**I have collaborated on investigations into the process of photosynthesis and I can demonstrate my understanding of why plants are vital to sustaining life on Earth. SCN 3-02a**

Learners should be able to:

* Describe the process of photosynthesis
* Describe the importance of photosynthesis to other organisms

**I can sample and identify living things from different habitats to compare their biodiversity and can suggest reasons for their distribution. SCN 3-01a**

Learners should be able to:

* Define Biodiversity – the variety of living things that is found in a particular place
* State that a habitat is a place or an area where organisms live.
* Describe a method of sampling living things (organisms) from different habitats, using at least two of the following methods:
	+ Quadrat
	+ Pitfall Trap
	+ Pond dipping
* Suggest reasons for the distribution of the organisms found
* State that in its habitat an animal must be able to find food, water shelter, and a mate.
* State that in its habitat a plant must be able to find light, water, space and nutrients.
* Within a food web there is interdependence. This means that all living things are involved in feeding relationships, either as predators or as prey. These relationships are very important to the survival of each of the species that are living together in one place.

**SCN I have extracted DNA and understand its function. I can express an informed view of the risks and benefits of DNA profiling.**

* Extract DNA
* Explain the function of DNA
* Describe DNA profiling
* Express an informed opinion on the benefits of DNA profiling

**S2 Chemistry**

Rocks

* recognise the different type of rocks: Igneous, Metamorphic and sedimentary.
* be able to classify some common rocks.
* describe the formation of rocks over thousands of years and the movement of soil.
* State that rocks can be broken down by the processes of weathering and erosion.
* Identify the difference between weathering and erosion.
* Give examples of weathering.
* Describe processes of erosion and how that allows for transportation of rocks.

Extraction useful substances

* Identify that a fuel is something which is burned to release energy
* Give examples of fossil fuels, including coal, oil and natural gas
* Explain the type of rock coal is and the type of rocks needed to allow oil resevoirs to form.
* Describe the process of extracting crude oil from the ground.
* State that crude oil is obtained from the ground as a mixture and must be separated into different fractions by difference in boiling point in order to be used.
* Recognise it is possible to extract useful substances from natural resources.
* Give the definition of an ore.
* Carry out some simple experiments to demonstrate this – **extraction of copper from copper oxide and extraction of copper from copper chloride must be carried out in this section of the course.**
* Can extract metals from metal oxides, rocks and minerals.
* State that unreactive metals can be found uncombined in the Earth’s crust or can be extracted with only heat.
* State that more reactive metals like iron must be extracted using heat and carbon.
* State that the most reactive metals are extracted using the process of electrolysis.
* State that there are different types of soils, in which different types of plants will grow.
* Give an example of an important medicinal compound extracted from plants.
* Explain that fermentation allows for the production of alcoholic drinks and that the type of alcoholic drink depends on the plant material that is fermented.
* Carry out steam distillation – **this is one of the mandatory experiments for this part of the course**.
* State that a prominent use of steam distillation is the extraction of essential oils.
* Identify essential oils as aroma compounds from plants and list some of their uses.

**S2 Physics**

Electricity

* Identify and draw circuit symbols
* Build series circuits for a desired purpose
* Build parallel circuits for a desired purpose
* Calculate the current in a series circuit
* Calculate the current in a parallel circuit
* Calculate voltage in a series circuit
* Calculate voltage in a parallel circuit
* Investigate resistance in a series and parallel circuit