Toynbee Curriculum
KS4 Topic Summaries

SCIENCE

Toynbee School

Scheme of Learning: Organisation

Topic Sequence:

1	2	3	4	5	6	7	8	9	10	11
Organisation	Electric Circuits	Chemical Changes	Mains Electricity	Quantitative Chemistry	Using Resources	Electro-Magnetism	Homeostasis & Response	Energy Changes	Ecology	Waves

Topic Overview:

In this topic we will learn about the human digestive system which provides the body with nutrients and the respiratory system that provides it with oxygen and removes carbon dioxide. In each case they provide dissolved materials that need to be moved quickly around the body in the blood by the circulatory system. Damage to any of these systems can be debilitating if not fatal. Although there has been huge progress in surgical techniques, especially with regard to coronary heart disease, many interventions would not be necessary if individuals reduced their risks through improved diet and lifestyle. We will also learn how the plant's transport system is dependent on environmental conditions to ensure that leaf cells are provided with the water and carbon dioxide that they need for photosynthesis

Lesson Sequence:

We build on the cells topic to show how cells work together to make tissues to organ systems with the digestive and respiratory systems as particular examples. We include the required practical activities in the process. We move onto looking at factors that have a negative impact on health and finish by describing the organ systems in plants.
The focus skill for this topic is '**evaluate**'.

Sequence of Lessons:

1	Cells, Tissues & Organs
2	The Human Digestive System
3	Digestive Enzymes
4	Amylase & pH *Required Practical*
5	Bile
6	Food Tests *Required Practical:* Glucose & Starch
7	Food Tests *Required Practical:* Protein & Fats. *Mid Topic Assessment: teacher marked*
8	Blood & Blood Vessels
9	The Heart
10	Helping the Heart
11	The Lungs
12	Breathing *Mid Topic Assessment 2: teacher marked*
13	Health Interactions
14	Risk Factors
15	Cancer
16	Plant Tissues and Organs
17	Transpiration
18	Revision: this is a big topic, so give two lessons to revision
19	Test

Supportive Reading:

Comprehension activity	The circulation system.
Literacy tasks	Literacy tasks in lessons 3, 4, 5, 7, 9, 10, 12, 17

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions based on the skill of 'evaluate'

Resources:

1	Worksheets in folder
2	Worksheets in folder. Cheese sandwich demo: cheese sandwich, washing up bowl, pestle & mortar, funnel and tube, clear plastic bag, tights, scissors, gloves, liquid labelled 'saliva', 'bile', 'enzymes', 'stomach acid'.
3	Exam question in folder
4	Iodine, dimple trays, water bath at 37°C, starch solution, solution labelled 'pH4' containing no amylase, solution labelled 'pH 8' containing high conc amylase, and solution labelled 'pH 10' containing a slightly lower conc of amylase, extra pipettes. Exam question foundation or higher: print separately.
5	Vegetable oil for demo.
6	Iodine, dimple trays, Benedict's solution, variety of foods to test
7	Biuret solution, Sudan III, variety of foods to test Mid topic assessment in folder.
8	Worksheets in folder
9	Hearts, dissection kit, gloves, bin bag, disinfectant for tables, comprehension activity.
10	Print the table on slide 3
11	Pluck, pump, dissection kit. Worksheets in folder.
12	Bell jar lungs model. Mid topic assessment in folder.
13	Board game (laminated in filing cabinet), dice, counters. Graphs and question sheet.
14	Nothing required
15	Cancer cause cards – in filing cabinet. Cancer exam question in folder.
16	Celery that has been kept in inky water. White tile, knife, microscopes. Phloem xylem sorting sheet.
17	Demo: two colours of ink and white tissue paper
18	Resources in shared area folder
19	Test in shared area folder

Scheme of Learning: Electric circuits

Topic Sequence:

1	2	3	4	5	6	7	8	9	10	11
Organisation	Electric Circuits	Chemical Changes	Mains Electricity	Quantitative Chemistry	Using Resources	Electro-Magnetism	Homeostasis & Response	Energy Changes	Ecology	Waves

Topic Overview:

Electric charge is a fundamental property of matter everywhere. Understanding the difference in the microstructure of conductors, semiconductors and insulators makes it possible to design components and build electric circuits. Many circuits are powered with mains electricity, but portable electrical devices must use batteries of some kind. Electrical power fills the modern world with artificial light and sound, information and entertainment, remote sensing and control.

Lesson Sequence:

The topic begins with the conventions of circuit diagrams including some symbols covered at KS3, but widening the range to include some more specific examples of the components used.
The main focus of the next few lessons is to cover the key concepts of charge, current, potential difference and resistance including the rules applied to series and parallel circuits.
This is then applied to two different required practicals – one looking at the resistance of a length of wire and the other plotting the current/potential difference graphs for three different components; a bulb, a resistor and a diode.
The final section of the topic looks at how the resistance of both LDRs and thermistors can vary and how this can be applied to control lighting or heating circuits.

Sequence of Lessons:		Resources:	
1	Charge and symbols	1	Worksheet – circuit symbols.
2	Current	2	Worksheet – Q=It. Yellow kit cells, bulbs, leads and ammeters
3	Potential difference	3	Worksheet – E=QV. Yellow kit cells, bulbs, leads and voltmeters
4	Resistance	4	Worksheet – calculating resistance, resistance cartoon
5	Resistance of a wire RP *Mid-topic assessment & Required Practical*	5	RP instruction sheet, variable power supplies, banjo wires, ammeters, voltmeters, crocodile clips, leads. Mid-topic assessment sheet
6	Series and parallel	6	Worksheet – series and parallel rules. Yellow kit cells, bulbs, leads, ammeters and voltmeters
7	Resistors in series and parallel RP	7	RP instruction sheet, variable power supplies, 10 Ω resistors, ammeters, voltmeters, croc clips, leads. Worksheet – circuit rules
8	Ohmic and non-ohmic conductors	8	Worksheet – gradient and tangent practise
9	Ohmic and non-ohmic components *Mid-topic assessment & Required Practical*	9	RP instruction sheet, variable power supplies, ray boxes, resistors, diodes, ammeters, voltmeters, multimeters, croc clips, leads. Mid-topic assessment sheet
10	Thermistors and LDRs	10	Thermistors, multimeters, kettles, thermometers, LDRs, light source, metre rulers
11	Revision	11	Revision resources
12	Test	12	Test

Supportive Reading:

Comprehension activity	TBC

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions based on the skill of calculate

Scheme of Learning: Chemical Changes

Topic Sequence:

1	2	3	4	5	6	7	8	9	10	11
Organisation	Electric Circuits	Chemical Changes	Mains Electricity	Quantitative Chemistry	Using Resources	Electro-Magnetism	Homeostasis & Response	Energy Changes	Ecology	Waves

Topic Overview:

Understanding of chemical changes began when people began experimenting with chemical reactions in a systematic way and organizing their results logically. Knowing about these different chemical changes meant that scientists could begin to predict exactly what new substances would be formed and use this knowledge to develop a wide range of different materials and processes. It also helped biochemists to understand the complex reactions that take place in living organisms. The extraction of important resources from the earth makes use of the way that some elements and compounds react with each other and how easily they can be 'pulled apart'.

Lesson Sequence:

We begin with a recap of what metals are and how they react with oxygen. Reduction and oxidation are explained only in terms of loss or gain of oxygen. We then place metals into the reactivity series using their reactions with water and acid. This leads onto how metals can be extracted from ores using reduction with carbon and then into displacement reactions. This forms the basis of a series of lessons on salt. Pupils need to know that salts can be made by reacting acid with metal, metal carbonates, metal oxide and metal hydroxides. We leave the metal hydroxides until we have introduced the pH scale and neutralisation. The second half of this topic is on electrolysis. Students must understand electrolysis of molten and aqueous solutions and higher tier students must learn ionic and half equations
The focus skill for this topic is 'explain'.

Sequence of Lessons:	
1	Metals & Oxygen
2	The Reactivity Series
3	Extracting Metals
4	Displacement Reactions
5	Acid + Metal Carbonates *(required practical)*
6	Acid + Metal Oxides *(required practical)*
7	Making Salts – *Mid topic assessment 1*
8	Neutralisation & pH Scale
9	Titration *(required practical TRIPLE ONLY)*
10	Introduction to Electrolysis
11	Electrolysis of Aqueous Solutions - *Mid topic assessment 2*
12	The Extraction of Aluminium
13	Revision
14	Test

Resources:	
1	Demo: strip of Mg, Cu, Fe and Zn
2	Demo: alkali metals, UI, trough & lid, scalpel and white tile. Class set: dimple trays, 1M HCl, Fe, Mg, Zn, Cu
3	Class set: crucibles & lids, clay triangles, copper oxide, charcoal.
4	Mg, Zn, Fe, Cu and their sulphate solutions. Dimple trays
5	1M sulphuric acid, magnesium carbonate
6	1M Sulphuric acid, copper oxide
7	n/a
8	HCl, NaOH, universal indicator
9	Burettes, sodium hydroxide, hydrochloric acid, phenolphthalein indicator
10	NaCl solution, powerpacks, leads, electrodes
11	n/a
12	n/a
13	n/a
14	Test in shared area folder

Supportive Reading:

Literacy task	The mid topic assessments provide an opportunity for feedback on longer written answers.

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions based on the skill of 'explain'.

Scheme of Learning: Mains electricity

Topic Sequence:

1	2	3	4	5	6	7	8	9	10	11
Organisation	Electric Circuits	Chemical Changes	Mains Electricity	Quantitative Chemistry	Using Resources	Electro-Magnetism	Homeostasis & Response	Energy Changes	Ecology	Waves

Topic Overview:

Electric charge is a fundamental property of matter everywhere. Electrical power fills the modern world with artificial light and sound, information and entertainment, remote sensing and control. The fundamentals of electromagnetism were worked out by scientists of the 19th century. However, power stations, like all machines, have a limited lifetime. If we all continue to demand more electricity this means building new power stations in every generation – but what mix of power stations can promise a sustainable future?

Lesson Sequence:

The topic begins with a look at the 'War of the Currents' addressing the part that Edison and Tesla played in the development of our current mains electricity system. This includes the concepts of alternating and direct current.
We then move onto the dangers of allowing mains electricity into our home and the safety precautions taken in order to lower the risks associated with this idea. This includes the UK 3-pin plug and the purpose of the individual components within it. A practical involving correctly wiring a 3-pin plug is included at this point. A comparison of fuses and circuit breakers is also covered at this point.
Next we move into the mathematical areas of power and energy including 4 formulae that need to be committed to memory, with lots of calculation practise covered here.
This is then all linked together by looking at the transportation of electricity around the country in the National Grid.
Separate scientists then move onto the final section of static electricity, considering how it is generated, how it can be reduced and how it is useful to us.

Sequence of Lessons:		Resources:	
1	A.C./D.C.	1	Worksheets – Edison vs Tesla, lesson summary worksheet
2	3-pin plug	2	Plug wiring kits, plug diagram, plug worksheet
3	Plug safety	3	Worksheet – GCSE question practise; fuse wire demonstration
4	Power *mid-topic assessment*	4	Worksheets – P=IV, P=I2R, mid-topic assessment
5	Work done	5	Worksheets – E=Pt, all power formula practise
6	The National Grid	6	Worksheet – the National Grid; card sort - NG
7	Static charge *separate physics only*	7	Balloon, pepper, rods and cloths
8	Electric fields *separate physics only*	8	Van der Graaff or force levitator
9	Revision	9	n/a
10	Test	10	n/a

Supportive Reading:

Comprehension activity	TBC

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions based on the skill of calculate

Scheme of Learning: Quantitative Chemistry

Topic Sequence:

1	2	3	4	5	6	7	8	9	10	11
Organisation	Electric Circuits	Chemical Changes	Mains Electricity	Quantitative Chemistry	Using Resources	Electro-Magnetism	Homeostasis & Response	Energy Changes	Ecology	Waves

Topic Overview:

Chemists use quantitative analysis to determine the formulae of compounds and the equations for reactions. Given this information, analysts can then use quantitative methods to determine the purity of chemical samples and to monitor the yield from chemical reactions. Chemical reactions can be classified in various ways. Identifying different types of chemical reaction allows chemists to make sense of how different chemicals react together, to establish patterns and to make predictions about the behaviour of other chemicals. Chemical equations provide a means of representing chemical reactions and are a key way for chemists to communicate chemical ideas.

Lesson Sequence:

We begin with balancing simple equations to apply the law of conservation of mass in chemical reactions. We then calculate the relative masses of elements and compounds, and the percentage by mass of particular elements within a compound.

Higher tier pupils need to be able to use the idea of the mole in calculations. We use moles to calculate the mass of particular reactants or products in a reaction when given the mass of another chemical, the limiting reactant in a given reaction and use the mass of chemicals to form balanced symbol equations.

All pupils; higher and foundation tier, need to be able to calculate the mass of a solute in a given volume of solution.

Separate Chemistry pupils also need to be able to calculate the yield and atom economy in reactions and build on their knowledge of titrations from the chemical changes topic to calculate the concentration of an unknown solution. Separate students finish with calculations of volumes of gases.

Sequence of Lessons:	
1	Conservation of Mass & Balancing Equations
2	Ar & Mr
3	Percentage by Mass – *mid topic assessment*
4	Moles
5	Equations & Calculations
6	Limiting Reactants
7	From Masses to Balanced Equations
8	Expressing Concentrations
9	Percentage Yield & Atom Economy – *Separate Chemistry Only*
10	Titration Calculations - *Separate Chemistry Only*
11	Volume of Gases - *Separate Chemistry Only*
12	Revision
13	Test

Resources:	
1	Worksheets in shared folder
2	Worksheets in shared folder
3	Worksheets in shared folder
4	Worksheets in shared folder
5	Worksheets in shared folder
6	Worksheets in shared folder
7	Worksheets in shared folder
8	Worksheets in shared folder
9	Worksheets in shared folder
10	Worksheets in shared folder
11	Worksheets in shared folder
12	Worksheets in shared folder
13	Test in shared folder

Supportive Reading:

Literacy tasks	TBC

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions based on the skill of 'calculate'.

Scheme of Learning: Using Resources

Topic Sequence:

1	2	3	4	5	6	7	8	9	10	11
Organisation	Electric Circuits	Chemical Changes	Mains Electricity	Quantitative Chemistry	Using Resources	Electro-Magnetism	Homeostasis & Response	Energy Changes	Ecology	Waves

Topic Overview:

Industries use the Earth's natural resources to manufacture useful products. In order to operate sustainably, chemists seek to minimise the use of limited resources, use of energy, waste and environmental impact in the manufacture of these products. Chemists also aim to develop ways of disposing of products at the end of their useful life in ways that ensure that materials and stored energy are utilised. Pollution, disposal of waste products and changing land use has a significant effect on the environment, and environmental chemists study how human activity has affected the Earth's natural cycles, and how damaging effects can be minimised.

Lesson Sequence:

We begin by defining renewable and finite resources as this forms the basis for the topic. We spend several lessons learning about how water is made safe to be released into the water ways and to drink. We move onto to learning about how metals – a finite resource – are extracted from their ores, and then the impact that products and services have on the environment by carrying out a life cycle assessment on them. We look at how to reduce the impact we have on the environment with recycling and reducing waste with a particular focus on the rusting and waste of metals.

Separate Chemistry pupils then go onto learn about the Haber process for making ammonia – a key ingredient in fertilisers

Sequence of Lessons:

1	Finite & Renewable Resources
2	Water Safe to Drink
3	Treating Waste Water
4	*Water Required Practical & mid topic assessment*
5	Extracting Metals from Ores – *Higher tier only*
6	Life Cycle Assessments
7	Reduce, Reuse, Recycle,
8	Rusting & Useful Alloys – *Separate Chemistry Only*
9	The Properties of Material - *Separate Chemistry Only*
10	The Haber Process - *Separate Chemistry Only*
11	Making Fertilisers - *Separate Chemistry Only*
12	Revision
13	Test

Supportive Reading:

Comprehension activity	Life Cycle Assessment Comprehension activity

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions based on the skill of 'describe'.

Resources:

1	n/a
2	Pringles tubes, Filter paper, Elastic bands Sand, Meshes, Gravel, Washing up bowls Dirty water containing mud, sand, bits of twigs etc.
3	n/a
4	Sea water (produced by dissolving 25g sodium chloride in 1dm^3 water, add sodium carbonate until the pH reaches 8.0-8.5), Spring water (0.1M magnesium sulphate solution, should have a pH of 5.5-6.5). Rainwater (distilled water acidified to produce a pH of 5.0 – 5.5). Sample X (any one of the above in an unlabelled bottle) , UI, Conical flask delivery tubes
5	Fact sheets on phytomining and bioleaching
6	LCA Comprehension sheet and questions
7	n/a
8	Iron nails, Bungs for test tubes, Cotton wool, Salt, Oil, Anhydrous calcium chloride Kettle (for the boiled water tube), Fact sheets on alloys (slides 16-17)
9	n/a
10	n/a
11	Possible practical if time: Burettes, Ammonia solution, Sulphuric acid
12	n/a
13	Test in shared area

Scheme of Learning: Magnetism and Electromagnetism

Topic Sequence:

1	2	3	4	5	6	7	8	9	10	11
Organisation	Electric Circuits	Chemical Changes	Mains Electricity	Quantitative Chemistry	Using Resources	Electro-Magnetism	Homeostasis & Response	Energy Changes	Ecology	Waves

Topic Overview:

Electromagnetic effects are used in a wide variety of devices. Engineers make use of the fact that a magnet moving in a coil can produce electric current and also that when current flows around a magnet it can produce movement. It means that systems that involve control or communications can take full advantage of this.

Lesson Sequence:

This topic begins with a detailed look at magnetism. It covers why some materials are magnetic, which materials are magnetic, the ideas of permanent and induced magnetism, how to make the invisible field around a magnet visible and what shape it is. These ideas are then linked together to explain how and why a directional compass works including a discussion of the magnetic field around the Earth.

The second half of the topic then looks at the phenomenon of electromagnetism. This begins with building and testing and electromagnet, before moving on to discuss its many applications including the Motor Effect. Students get the opportunity to build a simple d.c. motor and investigate the means of changing speed and direction of rotation before moving onto the equation F=Bil to study the reasons behind these effects.

Separate physicists then go on to study the Generator Effect and some of its applications including transformers. These are linked back to the Mains Electricity topics, but studied in more depth including the ability to make calculations.

Sequence of Lessons:		Resources:	
1	Magnetic fields	1	Bar magnets, iron filings, plotting compasses
2	What is a magnet?	2	Compass demo
3	Electromagnets	3	Variable power supply, iron core, electromagnet wires, leads and croc clips, steel core, glass core, wooden core, box of paperclips
4	Electromagnet uses *mid-topic assessment*	4	Worksheet – circuit diagrams
5	The Motor Effect	5	Motor kit, Magnadur magnets, variable power supply (grey ones are good here), leads and croc clips, demo – large horseshoe magnet, aluminium foil
6	The Motor Effect calculations	6	Demo – motor kit, length of very thick copper wire, croc clips and leads, variable power supply, top pan balance (small one is better), GCSE questions
7	The Generator Effect *separate physics only*	7	Coil of wire, milliammeter/multi-meter, croc clips and leads, bar magnet
8	Applications of the generator effect *separate physics only*	8	Worksheet – microphone and speaker, homemade speaker kits – half toilet tube, length of insulated wire, speaker cone template, testing kit
9	Transformers *separate physics only*	9	C-core and transformer demo
10	Revision	10	n/a
11	Test	11	n/a

Supportive Reading:

Comprehension activity	TBC

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions based on the skill of calculate

Scheme of Learning: Homeostasis & Response

Topic Sequence:

1	2	3	4	5	6	7	8	9	10	11
Organisation	Electric Circuits	Chemical Changes	Mains Electricity	Quantitative Chemistry	Using Resources	Electro-Magnetism	Homeostasis & Response	Energy Changes	Ecology	Waves

Topic Overview:

Cells in the body can only survive within narrow physical and chemical limits. They require a constant temperature and pH as well as a constant supply of dissolved food and water. In order to do this the body requires control systems that constantly monitor and adjust the composition of the blood and tissues. These control systems include receptors which sense changes and effectors that bring about changes. In this section we will explore the structure and function of the nervous system and how it can bring about fast responses. We will also explore the hormonal system which usually brings about much slower changes. Hormonal coordination is particularly important in reproduction since it controls the menstrual cycle. An understanding of the role of hormones in reproduction has allowed scientists to develop not only contraceptive drugs but also drugs which can increase fertility

Lesson Sequence:

Starting with an introduction to homeostasis, we look at how the nervous system allows us to respond to changes in our environment. We carry out the required practical to investigate reaction time before moving onto the endocrine system with a focus on blood glucose control and the menstrual cycle and the control of fertility.

Separate biology students then learn about plant hormones and look in more detail about homeostasis with a focus on temperature control and the function of the kidney.

Sequence of Lessons:		Resources:	
1	Homeostasis	1	Resources in shared folder
2	Structure & Function of the Nervous System	2	Resources in shared folder
3	Reflexes & Synapses	3	Resources in shared folder
4	Reaction Time *Required Practical & Mid-Topic Assessment*	4	Metre sticks
5	The Brain – *Separate Biology Only*	5	Resources in shared folder
6	The Eye – *Separate Biology Only*	6	Resources in shared folder
7	The Endocrine System	7	Resources in shared folder
8	Blood Glucose Control	8	Resources in shared folder
9	Diabetes *Mid-Topic Assessment*	9	Diabetes test strips, 'urine' samples – diabetic, healthy, concentrated, dilute
10	Hormones at Puberty	10	Resources in shared folder
11	Control of Fertility	11	Contraceptive fact sheets (laminated)
12	Plant Hormones – *Separate Biology Only*	12	Cress seeds, cotton wool. Boxes with holes cute on different sides.
13	Temperature Control & the Kidney – *Separate Biology Only*	13	Resources in shared folder
14	Kidney Failure & ADH – *Separate Biology Only*	14	Resources in shared folder
15	Revision	15	Resources in shared folder
16	Test	16	Resources in shared folder

Supportive Reading:

Comprehension activity	

Assessment:

Knowledge:	Multiple choice and short answer questions
Application of Knowledge:	End of topic test

Scheme of Learning: Energy Changes

Topic Sequence:

1	2	3	4	5	6	7	8	9	10	11
Organisation	Electric Circuits	Chemical Changes	Mains Electricity	Quantitative Chemistry	Using Resources	Electro-Magnetism	Homeostasis & Response	Energy Changes	Ecology	Waves

Topic Overview:

Energy changes are an important part of chemical reactions. The interaction of particles often involves transfers of energy due to the breaking and formation of bonds. Reactions in which energy is released to the surroundings are exothermic reactions, while those that take in thermal energy are endothermic. These interactions between particles can produce heating or cooling effects that are used in a range of everyday applications. Some interactions between ions in an electrolyte result in the production of electricity. Cells and batteries use these chemical reactions to provide electricity. Electricity can also be used to decompose ionic substances and is a useful means of producing elements that are too expensive to extract any other way.

Lesson Sequence:

This topic begins with a practical investigation into temperature changes that occur during chemical reactions. We classify these reactions as exothermic or endothermic. We then quantify the energy change in graphical form with energy profiles and by calculating the bond energy.

Separate Chemistry students then look at chemical and fuel cells by describing how they work and evaluating their use.

Sequence of Lessons:

1	Exothermic & Endothermic Reactions
2	*Required Practical:* temperature change
3	Required Practical Write Up *Mid-topic assessment*
4	Energy Profiles & Bond Energy Calculations
5	Chemical & Fuel Cells (Separate Chemistry Only)
6	Revision
7	Test

Resources:

1	Demo: Barium hydroxide + Ammonium chloride, block of wood, gloves. Class Practical: calcium chloride, sodium bicarbonate solution, citric acid, hydrochloric acid, sodium hydroxide, sulphuric acid, magnesium strips (3cm), magnesium powder, copper sulphate solution
2	Polystyrene cups & lids, HCl 1M, NaOH
3	Exam Qs
4	n/a
5	Lemons, Mg, Fe, Cu, Zn strips, voltmeters (or mulitmeter), croc clips, wires
6	Resources in shared folder
7	Test in shared area folder

Supportive Reading:

TBC	

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions based on the skill of 'plan a method'

Scheme of Learning: Ecology

Topic Sequence:

1	2	3	4	5	6	7	8	9	10	11
Organisation	Electric Circuits	Chemical Changes	Mains Electricity	Quantitative Chemistry	Using Resources	Electro-Magnetism	Homeostasis & Response	Energy Changes	Ecology	Waves

Topic Overview:

The Sun is a source of energy that passes through ecosystems. Materials including carbon and water are continually recycled by the living world, being released through respiration of animals, plants and decomposing microorganisms and taken up by plants in photosynthesis. All species live in ecosystems composed of complex communities of animals and plants dependent on each other and that are adapted to particular conditions, both abiotic and biotic. These ecosystems provide essential services that support human life and continued development. In order to continue to benefit from these services humans need to engage with the environment in a sustainable way. In this section we will explore how humans are threatening biodiversity as well as the natural systems that support it. We will also consider some actions we need to take to ensure our future health, prosperity and well-being.

Lesson Sequence:

We begin by building on the key stage three knowledge of food chains to describe some key terminology for ecology. We look at the adaptations of organisms to help them complete in their habitats and how energy is transferred through the food chain. The required practical utilises maths skills to sample the population of plants in an ecosystem.

We then look at wider ecological issues such as how water and carbon are cycled through the environment and the consequences of human action in terms of land, air and water pollution. We describe possible solutions to the biodiversity crisis.

In addition, separate Biology students study the role of decay in the environment and the challenges facing our food security and the possible solutions to it.

Sequence of Lessons:		Resources:	
1	Communities, Biotic & Abiotic Factors	1	Resources in shared folder
2	Adaptations	2	n/a
3	Competition – *mid topic assessment*	3	Resources in shared folder
4	Feeding Relationships	4	Resources in shared folder
5	Trophic Levels – *Separate Biology Only*	5	Resources in shared folder
6	Sampling – *Required Practical*	6	Depending on weather either quadrats, 100m measuring tape OR sampling the lawn sheet
7	Water & Carbon Cycles	7	Resources in shared folder
8	Decomposition – *Separate Biology Only Required Practical*	8	Milk, water bath at 35, universal indicator paper, cling film
9	Land & Water Pollution	9	n/a
10	Global Warming & Air Pollution - *mid topic assessment*	10	Resources in shared folder
11	Maintaining Biodiversity	11	Resources in shared folder
12	Food Security – *Separate Biology Only*	12	Resources in shared folder
13	Revision	13	Resources in shared folder
14	Test	14	Test in shared folder

Supportive Reading:

Comprehension activity	Maintaining biodiversity

Assessment:

Knowledge:	Multiple choice and short answer questions
Application of Knowledge:	End of topic test

Scheme of Learning: Waves

Topic Sequence:

1	2	3	4	5	6	7	8	9	10	11
Organisation	Electric Circuits	Chemical Changes	Mains Electricity	Quantitative Chemistry	Using Resources	Electro-Magnetism	Homeostasis & Response	Energy Changes	Ecology	Waves

Topic Overview:

Wave behaviour is common in both natural and man-made systems. Waves carry energy from one place to another and can also carry information. Designing comfortable and safe structures such as bridges, houses and music performance halls requires an understanding of mechanical waves. Modern technologies such as imaging and communication systems show how we can make the most of electromagnetic waves.

Lesson Sequence:

This topic begins with a recap of the information covered at KS3 including all the vocabulary needed to describe a wave. It then moves on to introduce the wave equation and apply it to both waves in water (the ripple tank) and waves in solids (standing wave generator) in the first required practical of the topic.
Then the topic focuses on ray diagrams and the behaviour of light as it meets a boundary. Moving onto other type of waves for the separate physicists including sound, ultrasound and seismic waves.
All students then look in detail at the electromagnetic spectrum including a required practical on infra red radiation.
Finally, separate physicists then look in detail at the behaviour of light through lenses, the science of colour and why the nature of the surface of an object affects how much radiation it absorbs, emits or reflects.

Sequence of Lessons:		Resources:	
1	Describing a wave	1	Slinky, worksheet – wave diagram
2	The wave equation	2	Worksheet – the wave equation
3	Measuring waves RP *mid-topic assessment*	3	Ripple tank, metre ruler, large sheet of card, signal generator, standing wave equipment, worksheet – RP instructions
4	Reflection and refraction	4 &5	Coin and mug, ray box + slit, variable power supply, mirror and stand, glass/perspex block, A3 paper, protractor, worksheet – RP instructions
5	Refraction RP *separate physics only*		
6	Lenses *separate physics only*	6	Ray box + triple slit, variable power supply, convex lens, concave lens, graph paper
7	Visible light *separate physics only* mid-topic assessment	7	Coloured glasses, filters
8	Sound waves *separate physics only*	8	Sig gen, loudspeaker and oscilloscope, worksheet – ghostbusters, ear model, worksheet – ear diagram
9	Ultrasound *separate physics only*	9	Worksheet – ultrasound calculations
10	Seismic waves *separate physics only*	10	n/a
11	Electromagnetic spectrum	11	Worksheet – e-m spectrum cut and stick
12	Producing electromagnetic waves	12	n/a
13	Infra red RP *mid-topic assessment*	13	Leslie cube, IR detector, kettle, worksheet – RP instructions
14	Black bodies *separate physics only*	14	Information sheet – electromagnetic spectrum
15	Revision	15	n/a
16	Test	16	n/a

Supportive Reading:

Comprehension activity	TBC

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions based on the skill of calculate

Scheme of Learning: Forces – energy and interactions

Topic Sequence:

1	2	3	4	5	6
Forces & Interactions	**Organic Chemistry**	**Inheritance, Variation & Evolution**	**Forces & Motion**	**Chemical Analysis**	**Space (triple only)**

Topic Overview:

Engineers analyse forces when designing a great variety of machines and instruments, from road bridges and fairground rides to atomic force microscopes. Anything mechanical can be analysed in this way. Recent developments in artificial limbs use the analysis of forces to make movement possible.

Lesson Sequence:

We begin by introducing the ideas of scalar and vector quantities, and that force is a vector quantity that is represented by an arrow with both magnitude and direction. Forces form part of a system that can be in balance or can be unbalanced. Unbalanced forces lead to a resultant force which can be in the direction of one of the existing forces or at an angle. These lessons develop the understanding of how to construct a diagram to calculate the size and direction of a resultant force. Finally, in this section, the specific force of gravity is then investigated.
We then revisit the ideas of energy stores and work done, relating them to the forces causing the transfer of energy. This includes looking at Hooke's Law in a required practical.
The final section of content is for separate physics students and looks at the turning effects of a force and the pressure caused by objects interacting.

Sequence of Lessons:	
1	Scalar & Vector
2	Contact, non-contact & Resultant Forces
3	Parallelograms of Force *(Higher tier only)*
4	Resolution of Force *(Higher tier only) mid-topic assessment*
5	Weight, Mass & Gravity
6	Work Done
7	Hooke's Law *Required Practical & mid-topic assessment*
8	Moments – *Separate Physics Only*
9	Levers & Gears - *Separate Physics Only*
10	Pressure in solids & liquids - *Separate Physics Only*
11	Atmospheric Pressure -*Separate Physics Only mid-topic assessment*
12	Revision
13	Test

Resources:	
1	Worksheet
2	Worksheet
3	Worksheet
4	Worksheet
5	Worksheet
6	Worksheet
7	Spring, 100g masses and mass hanger, metre ruler, clamp stand, RP worksheet
8	Worksheet
9	Lego gear sets, cog demo board, GCSE questions
10	Worksheet – ice road truckers sheets
11	Empty drinks cans, ice cream tubs
12	n/a
13	Test in folder

Supportive Reading:

TBC	

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions

Scheme of Learning: Organic Chemistry

Topic Sequence:

1	2	3	4	5	6
Forces & Interactions	Organic Chemistry	Inheritance, Variation & Evolution	Forces & Motion	Chemical Analysis	Space (Separate Physics only)

Topic Overview:

The chemistry of carbon compounds is so important that it forms a separate branch of chemistry. A great variety of carbon compounds is possible because carbon atoms can form chains and rings linked by C-C bonds. This branch of chemistry gets its name from the fact that the main sources of organic compounds are living, or once-living materials from plants and animals. These sources include fossil fuels which are a major source of feedstock for the petrochemical industry. Chemists are able to take organic molecules and modify them in many ways to make new and useful materials such as polymers, pharmaceuticals, perfumes and flavourings, dyes and detergents.

Lesson Sequence:

We begin this topic with an introduction to hydrocarbons and the structure and properties of alkanes. We describe how the different length chains of hydrocarbons are separated from crude oil by fractional distillation. We then look at hydrocarbons as fuels and describe the process of combustion and how the more useful, smaller chained hydrocarbons can be made from cracking the more abundant but less useful longer chains.

Separate Chemistry pupils then move onto more complex organic chemistry with the description of the structural formulas and reactions of alkenes, carboxylic acids, esters and alcohols. We finish by looking at polymerisation in both synthetic and natural compounds.

Sequence of Lessons:	
1	Introduction to Hydrocarbons
2	Fractional Distillation
3	Combustion – *mid topic assessment*
4	Cracking
5	Alkenes – *Separate Chemistry Only*
6 & 7	Alcohols, Carboxylic Acids & Esters – *Separate Chemistry Only*
8	Polymerisation – *Separate Chemistry Only*
9	Natural Polymers – *Separate Chemistry Only*
10	Revision
11	Test

Resources:	
1	Resources in shared folder
2	Resources in shared folder
3	Resources in shared folder
4	Demo of cracking: ceramic wool soaked in paraffin, boiling tube and delivery tube, trough, broken pot catalyst, bromine solution, test tubes and bungs.
5	n/a
6 & 7	Resources in shared folder
8	n/a
9	DNA diagram
10	Resources in shared folder
11	Test in shared folder

Supportive Reading:

Comprehension activity	TBC

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions

Scheme of Learning: Inheritance, Variation & Evolution

Topic Sequence:

1	2	3	4	5	6
Forces & Interactions	Organic Chemistry	Inheritance, Variation & Evolution	Forces & Motion	Chemical Analysis	Space (Separate Physics only)

Topic Overview:

In this section we will discover how the number of chromosomes are halved during meiosis and then combined with new genes from the sexual partner to produce unique offspring. Gene mutations occur continuously and on rare occasions can affect the functioning of the animal or plant. These mutations may be damaging and lead to a number of genetic disorders or death. Very rarely a new mutation can be beneficial and consequently, lead to increased fitness in the individual. Variation generated by mutations and sexual reproduction is the basis for natural selection; this is how species evolve. An understanding of these processes has allowed scientists to intervene through selective breeding to produce livestock with favoured characteristics. Once new varieties of plants or animals have been produced it is possible to clone individuals to produce larger numbers of identical individuals all carrying the favourable characteristic. Scientists have now discovered how to take genes from one species and introduce them in to the genome of another by a process called genetic engineering. In spite of the huge potential benefits that this technology can offer, genetic modification still remains highly controversial.

Lesson Sequence:

We begin by looking at the cellular level of gamete formation and reproduction and then onto how the inheritance of alleles causes variation and inherited disorders. We learn to interpret Punnet squares and family tree diagrams. We then turn to species level inheritance with the interplay of environment and genes on variation which leads onto natural selection. We learn about the evidence for natural selection in the form of fossils and bacterial resistance to antibiotics. We again interpret diagrams in the form of evolutionary trees which leads on from an understanding of extinction. GCSE Biology pupils then have extra lessons on the various theories of evolution and scientists behind them. Everyone then goes onto learn about how inheritance can be manipulated by humans in selective breeding and genetic engineering. We finish with a lesson on classification.

Sequence of Lessons:		Resources:	
1	Meiosis	1	Worksheets in shared folder.
2	Sex Vs Asexual Reproduction ***Biology only***	2	n/a
3	DNA & Genome	3	Worksheets in shared folder.
4	DNA Structure ***Biology only***	4	Worksheets in shared folder.
5	Genetic Inheritance	5	Worksheets in shared folder.
6	Family Trees	6	Worksheets in shared folder.
7	Inherited Disorders	7	n/a
8	Variation & Natural Selection ***Mid topic assessment***	8	Exam Question In folder
9	Natural Selection & Fossils	9	n/a
10	Evolutionary Trees & Extinction	10	Worksheet in shared folder.
11	Antibiotic Resistance	11	n/a
12	Darwin & Lamarck ***Biology only***	12	Exam Q in shared folder
13	Gregor Mendel ***Biology only***	13	Exam Q in shared folder
14	Alfred Russell Wallace ***Biology only***	14	n/a
15	Selective Breeding	15	n/a
16	Genetic Engineering	16	GM organisms laminated info sheets in filing cabinet
17	Cloning ***Biology only***	17	n/a
18	Classification	18	n/a
19	Revision	19	Worksheets in shared folder.
20	Test	20	In shared folder.

Supportive Reading:

	TBC

Assessment:

Knowledge:	Multiple choice and short answer questions
Application of Knowledge:	Exam questions

Scheme of Learning: Forces – energy and interactions

Topic Sequence:

1	2	3	4	5	6
Forces & Interactions	Organic Chemistry	Inheritance, Variation & Evolution	Forces & Motion	Chemical Analysis	Space (Separate Physics only)

Topic Overview:

Engineers analyse forces when designing a great variety of machines and instruments, from road bridges and fairground rides to atomic force microscopes. Anything mechanical can be analysed in this way. Recent developments in artificial limbs use the analysis of forces to make movement possible.

Lesson Sequence:

This topic continues on from the topic of forces and interactions by revisiting the idea of scalar and vector quantities, but focusing on displacement and velocity in a straight line. With a brief look at motion in a circle we then move into the detail of motion graphs (this is also covered in Maths) and the calculation of acceleration, either when distance is unknown or when time is unknown, including a brief introduction of the 'suvat' quantities. The section focusing on motion in a straight line finishes with the concept of terminal velocity and how it can be applied to various situations.
The topic then moves onto Newton's Laws of motion including a required practical to investigate his second law. This also covers the concept of inertia and inertial mass.
Stopping distances are covered in a single lesson, looking at the definition and the factors that can affect the distance covered when a vehicle stops. This directly relates to information contained within the theory driving test later in life.
Finally the topic considers momentum and the conservation of momentum as applied to collisions and explosions. With, for separate physics, an extra look at the concept of impulse and how it is the basis for all crash safety measures used.

Sequence of Lessons:		Resources:	
1	Displacement and velocity	1	n/a
2	Circular motion	2	Bungs on strings, plastic tubes, 100g mass hangers, timers, GCSE question
3	Distance-time graphs	3	Worksheet – tortoise and hare graph, GCSE question
4	Acceleration (including SUVAT)	4	Worksheet – acceleration calculations, Worksheet – SUVAT calculations
5	Velocity-time graphs mid-topic assessment	5	Worksheet – velocity-time graph, GCSE questions
6	Terminal velocity	6	Cake cases, metre rulers, timers
7	Newton's 1st Law	7	Trolley, ramp, timer, metre ruler, GCSE question
8	Newton's 2nd Law including *Required practical &* mid-topic assessment	8	Worksheet – RP instructions, light gates, data logger, metre ruler, 50g masses and hanger, string, trolley, 10cm x 5cm card linear air track and pump, GCSE question
9	Newton's 3rd Law and Inertia	9	Trolley with 2 vertical screws, thick elastic band, film canister, selection of masses to fit in canister
10	Stopping distances	10	30cm rulers, calculators, GCSE question
11	Momentum and conservation of momentum	11	Gauss gun demo, newton's cradle demo, GCSE question
12	Momentum and impulse *separate physics only*	12	GCSE questions
13	Revision	13	n/a
14	Test	14	n/a

Supportive Reading:

Comprehension activity	TBC

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions

Scheme of Learning: Chemical Analysis

Topic Sequence:

1	2	3	4	5	6
Forces & Interactions	Organic Chemistry	Inheritance, Variation & Evolution	Forces & Motion	**Chemical Analysis**	Space (Separate Physics only)

Topic Overview:

Analysts have developed a range of qualitative tests to detect specific chemicals. The tests are based on reactions that produce a gas with distinctive properties, or a colour change or an insoluble solid that appears as a precipitate. Instrumental methods provide fast, sensitive and accurate means of analysing chemicals, and are particularly useful when the amount of chemical being analysed is small. Forensic scientists and drug control scientists rely on such instrumental methods in their work.

Lesson Sequence:

This topic builds upon previously learnt knowledge of the difference between elements, mixtures and compounds to make a distinction between chemically pure and impure substances and how to identify them from each other. We then defined formulation as purposefully designed impure substances.

Pupils will have carried out chromatography in KS3 and in the year 9 Atomic Structure topic, but we revisit it now as a required practical and learn how to analyse chromatograms to identify unknown substances. Continuing with identifying substances, we then move onto the chemical tests for hydrogen, oxygen, carbon dioxide and chlorine.

The rest of the topic is for Separate Chemistry pupils only. We use flame tests and chemical tests to identify positive and negative ions as a required practical. We finish the topic learning about how instrumental analysis identifies unknown substances.

Sequence of Lessons:

1	Pure Substances & Formulations
2	Chromatography – *Required Practical*
3	Chromatography Theory – *mid topic assessment Qs*
4	Testing for Gases
5	Tests for Positive ions - Separate Chemistry Only *Required practical*
6	Tests for Negative ions - Separate Chemistry Only *Required practical*
7	Testing Unknown ions - Separate Chemistry Only
8	Instrumental Analysis - Separate Chemistry Only
9	Revision
10	Test

Supportive Reading:

Comprehension activity	TBC

Assessment:

Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions

Resources:

1	Washing up liquid, oil – separate in class set of beakers
2	Chromatography paper, paper clips, food colouring A-D and unknown
3	n/a
4	Mg, HCl, Decibel meter, $CaCO_3$ chips of different sizes, Limewater, H_2O_2, MnO_2, Delivery tubes (with conical flasks).
5	Compound powders of Li, Na, K, Ca and Cu NaOH, Solutions of Cu, Fe (II), Fe (III), Mg, Ca and Al
6	Silver Nitrate solution, Barium Chloride solution, HCl, limewater, Calcium Carbonate powder, Solutions of NaCl, KBr and KI Nitric acid and Silver nitrate, HCl, limewater Barium Chloride solution
7	NaOH, $MgCO_3$ powder and solution NaCl powder and solution, KI powder and solution, $CuSO_4$ powder and solution, Silver Nitrate solution, Barium Chloride solution, HCl, limewater
8	n/a
9	n/a
10	Test in shared folder

Scheme of Learning: Space: Physics GCSE Only

Topic Sequence:

1	2	3	4	5	6
Forces & Interactions	Organic Chemistry	Inheritance, Variation & Evolution	Forces & Motion	Chemical Analysis	Space (Separate Physics only)

Topic Overview:

Questions about where we are, and where we came from, have been asked for thousands of years. In the past century, astronomers and astrophysicists have made remarkable progress in understanding the scale and structure of the universe, its evolution and ours. New questions have emerged recently. 'Dark matter', which bends light and holds galaxies together but does not emit electromagnetic radiation, is everywhere – what is it? And what is causing the universe to expand ever faster?

Lesson Sequence:

We start locally with our solar system, and the life cycle of stars, then we link back to forces and circular motion as it's applied to orbits of satellites. We end with learning about the ideas on how the universe begin and how it is predicted to end.

Sequence of Lessons:	
1	The Solar System
2	Life of a Star
3	Planets. Satellites & Orbits
4	The Expanding Universe
5	Revision
6	Test

Resources:	
1	Solar system labelling diagram
2	Exam question
3	Exam question
4	Exam question, spectral tube demonstration
5	Revision resources in folder
6	Test

Supportive Reading:	
	TBC

Assessment:	
Knowledge:	Multiple choice and short answer questions.
Application of Knowledge:	Exam questions