Curriculum Overview – Science

Introduction

This document outlines **the curriculum and key considerations** including:

- Aims and purpose
- Alignment with the whole school provision and curriculum intent
- A summary programme of study which includes sequencing of taught content

We use the National Curriculum as our statutory foundation and broadly share its principles and aims including:

- 'To provide students with an introduction to the essential knowledge that they need to be educated citizens. To introduce students to the best that has been thought and said; and help engender an appreciation of human creativity and achievement'.
- To prepare students to be confident in themselves, to have a fulfilled and successful life beyond our school – one where they contribute positively to society.
- Our statutory curriculum is just one element in the education of every child. There is time and space in the school day and in each week, term and year to range beyond statutory specifications.
- Provision of a framework of core knowledge around which teachers can develop exciting and stimulating lessons to promote the development of students' knowledge, understanding and skills as part of the wider school curriculum.
- The wider school curriculum includes an extensive range of opportunities and activities that are routinely available to students, are inclusive and reflect our diverse community.

Numeracy and literacy

Teachers should take opportunities to develop students' mathematical fluency, spoken language, reading, writing and vocabulary within their specific discipline and in line with the expectations laid out in our school curriculum statement.

Purpose of study

Our department vision is to stimulate a lifelong curiosity which allows students to understand and contribute to the wider world and to begin their journey to reshape the world around them. We aim to excite, enthuse, and engage our young people with the world around them and to develop skills and knowledge so that they can be successful learners. The curriculum reflects our vision and provides opportunities for students to ask questions, to investigate through experimental work and ensures that every student can achieve to the best of their ability. We have high expectations of both teachers and students in ensuring that experiences in the classroom both challenge and support all.

Wolfreton Curriculum Intent

Our Science curriculum is underpinned by our Intent statement, or strapline:

Science is organised curiosity; always question, always wonder!

Curriculum Aims

The Wolfreton curriculum for science aims to ensure that all students:

- develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics
- develop understanding of the nature, processes, and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them
- are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future and develop an interest and curiosity about science and careers in science
- can review evidence to make informed choices in their future life
- inspire the next generation of post 16 students to continue scientific study

Building on prior learning

Building on their learning from Key Stage 1, students should have secured the following knowledge by the end of their primary school science curriculum.

Biology

- Identify and **describe the functions of different parts of flowering plants**: roots, stem-trunk, leaves, and flowers
- **Explore the requirements of plants for life and growth** (air, light, water, nutrients from soil, and room to grow
- **Know the part that flowers** play in the life cycle of flowering plants, including pollination, seed formation, and seed dispersal.
- **Identify** that humans and some other animals have skeletons and muscles for support, protection, and movement.
- **Explore and use classification keys to help group, identify, and name** a variety of living things in their local and wider environment.
- **Describe the simple functions** of the basic parts of the digestive system in humans.

- Identify the different types of teeth in humans and their simple functions.
- Construct and interpret a variety of food chains, identifying producers, predators, and prey.
- Describe the difference in the life cycles of a mammal, an amphibian, an insect, and a bird.
- Describe the life process of reproduction in some plants and animals.
- Describe the changes as humans develop into old age.
- Identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels, and blood.
- Describe the ways in which nutrients and water are transported within animals, including humans.
- Identify how animals and plants are adapted to suit their environment in different ways, and that adaptation may lead to evolution.

Chemistry

- Compare and group together different kinds of rocks based on their appearance and simple physical properties.
- Describe in simple terms how fossils are formed when things that have lived are trapped within rock.
- Recognise that soils are made from rocks and organic matter.
- Compare and group materials together, according to whether they are solids, liquids or gases.
- Observe that some materials change state when they are heated or cooled.
- Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.
- Compare and group together everyday materials based on their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets.
- Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating.

Physics

- Compare and group together a variety of everyday materials based on whether they are attracted to a magnet and identify some magnetic materials.
- Describe magnets as having two poles.
- Identify how sounds are made, associating it with vibration.
- Recognise that sounds get fainter as the distance from the sound source increases.
- Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches, and buzzers.
- Use recognised symbols when representing a simple circuit in a diagram.
- Recognise some common conductors and insulators, and associate metal with being good conductors.
- Describe the movement of the Earth, and other planets, relative to the Sun in the solar system.
- Describe the movement of the Moon relative to the Earth.
- Identify the effects of air resistance, water resistance and friction, that act between moving surfaces.

- Recognising that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.
- Use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye.
- Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes.
- Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.

What can students do by the end of KS2?

Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary

- taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
- recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
- using test results to make predictions to set up further comparative and fair tests
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations
- identifying scientific evidence that has been used to support or refute ideas or arguments.

What are the knowledge and skills gaps?

- Forming hypotheses and predictions
- Recording and presenting data
- Planning experiments

Curriculum Structure

The deliberate teaching of health and safety forms the foundation to building practical skills that students apply to plan valid experiments, develop a range of measuring and observing skills which build in complexity over time. The ability to analyse patterns, describing and explaining phenomena is critical to developing our student ability to think like a Scientist. We collaborate with our Mathematics department to use a common language and calculation methods across the Science and Maths based subjects. Examples include learning how to apply a line of best fit to a scatter graph, use standard form in the context of science and rearrange algebraic equations to change the subject of formulae.

Subject Discipline	Substantive threads	Disciplinary threads
Biology	• Cells and organisms • Organisation • Infection and response • Bioenergetics • Homeostasis and response • Inheritance, evolution and inheritance • Ecology	Applying Knowledge and Understanding • Using contextual knowledge to new situations and processes Variables • Understanding and using independent, dependent and control variables to plan and conduct fair and valid investigations Methods • Communicate procedural approaches and processes Data and graphs • Collecting and presenting scientific results in appropriate formats Conclusions • Explaining patterns using scientific ideas and concepts Evaluations • Considering strengths and weaknesses of practice and identifying areas for improvement. Theories and hypotheses • Testing hypothesis and reviewing theories
Chemistry	• Particulate nature • Chemical reactions • Atomic structure and the periodic table • Rocks and materials • Energy changes • Quantitative chemistry • Organic chemistry • Chemical analysis	
Physics	• Energy • Electricity • Particle model • Atomic structure • Forces • Waves • Magnetism and electromagnetism • Space	

Curriculum Sequencing

Key Stage 3: Year 7 – Long Term Planning

Autumn term	Biology	Chemistry	Physics
Substantive Knowledge	**Cells and organisation** • Cells as the fundamental unit of living organisms, including how to observe, interpret and record cell structure using a light microscope • The functions of the cell wall, cell membrane, cytoplasm, nucleus, vacuole, mitochondria and chloroplasts • The similarities and differences between plant and animal cells • The role of diffusion in the movement of materials in and between cells • The hierarchical organisation of multicellular organisms: from cells to tissues to organs to systems to organisms • A word summary for aerobic respiration	**Particles substances and mixtures** • The properties of the different states of matter (solid, liquid and gas) in terms of the particle model, including gas pressure. • Changes of state in terms of the particle model. • The differences in arrangements, in the motion and in the closeness of particles, explaining changes of state. • Changes in temperature in the motion of particles. • The concept of pure substances and mixtures, including dissolving. • The identification of pure substances. • Diffusion in terms of the particle model. • Simple techniques for separating mixtures: filtration, evaporation, distillation and chromatography.	**Fundamentals of physics** • Forces are pushes or pulls, arising from the interaction between two objects. • Force arrows in diagrams are used to model forces, adding forces in one dimension, balanced and unbalanced forces. • Forces associated with deforming objects; stretching and squashing – springs; with rubbing and friction between surfaces. • Forces measured in newtons, measurements of stretch or compression as force is changed. • Non-contact forces: gravity forces acting at a distance on Earth and in space; opposing forces and equilibrium: weight held by stretched spring or supported on a compressed surface. • Forces being needed to cause objects to stop or start moving, or to change their speed or direction of motion (qualitative only); change depending on direction of force and its size.

Disciplinary Skills	• Ask questions based on observations of the real world • Plan and carry out the most appropriate types of scientific enquiries • Use appropriate techniques and apparatus, paying attention to health and safety • Make and record observations and measurements using a range of methods for different investigations • Apply mathematical concepts and calculate results • Present observations and data using appropriate methods, including tables • Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions • Use SI units and use and derive simple equations and carry out appropriate calculations	• Ask questions based on observations of the real world. • Plan and carry out the most appropriate types of scientific enquiries. • Use appropriate techniques and apparatus, paying attention to health and safety. • Make and record observations and measurements using a range of methods for different investigations. • Present observations and data using appropriate methods, including tables. • Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions. • Use SI units.	• Pay attention to objectivity and concern for repeatability and reproducibility. • Scientific methods and theories develop over time partly due to peer review. • Ask questions and develop a line of enquiry based on observations of the real world. • Plan and carry out the most appropriate types of scientific enquiries. • Use appropriate techniques, apparatus, paying attention to health and safety. • Make and record observations and measurements using a range of methods for different investigations. • Apply mathematical concepts and calculate results. • Present observations and data using appropriate methods, including tables. • Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions. • Understand and use SI units. • Undertake basic data analysis including simple statistical techniques.
Assessment	End of topic assessment	End of topic assessment	End of topic assessment Cumulative assessment which assesses the first three units in early January.
Spring Term	Biology	Chemistry	Physics
Substantive knowledge	Organ systems	Chemical changes	Sound and light

	• The structural adaptations of some unicellular organisms. • The structure and functions of the human skeleton, to include support, protection, movement and making blood cells. • Biomechanics – the interaction between skeleton and muscles, including the measurement of force exerted by different muscles. • The function of muscles and examples of antagonistic muscles. • The tissues and organs of the human digestive system, including adaptations to function and how the digestive system digests food. • The structure and functions of the gas exchange system in humans, including adaptations to function. • The mechanism of breathing to move air in and out of the lungs, using a pressure model to explain the movement of gases, including simple measurements of lung volume.	• Differences between atoms, elements and compounds. • Chemical symbols and formulae for elements and compounds. • Conservation of mass in chemical reactions. • Chemical reactions as the rearrangement of atoms. • Representing chemical reactions using formulae and using equations. • Combustion, thermal decomposition and oxidation reactions. • Exothermic and endothermic chemical reactions. • The properties of metals and non-metals.	• Frequencies of sound waves, measured in hertz (Hz); echoes, reflection and absorption of sound • Sound needs a medium to travel, the speed of sound in air, in water, in solids • Sound produced by vibrations of objects and the ear drum; auditory range of humans and animals. • Transferring energy; use for cleaning and physiotherapy by ultra-sound. • Light waves travelling through a vacuum; speed of light • The transmission of light through materials: absorption, diffuse scattering and specular reflection at a surface • Use of ray model to explain imaging in mirrors, the pinhole camera, the refraction of light and action of convex lens in focusing (qualitative); the human eye • Light transferring energy from source to absorber leading to chemical and electrical effects; photo-sensitive material in the retina and in cameras • Colours; differential colour effects in absorption and diffuse reflection.
Disciplinary skills	• Pay attention to objectivity and concern for accuracy and precision. • Ask questions and develop a line of enquiry based on observations of the real	• Pay attention to objectivity and concern for accuracy and precision. • Ask questions and develop a line of enquiry based on observations of the real	• Pay attention to objectivity and concern for, repeatability and reproducibility • Understand that scientific methods and theories develop as earlier explanations are modified to take account of new

	world, alongside prior knowledge and experience. • Make predictions using scientific knowledge and understanding. • Plan and carry out the most appropriate types of scientific enquiries, including identifying independent, dependent and control variables, where appropriate. • Use appropriate techniques, apparatus and materials during fieldwork and laboratory work, paying attention to health and safety. • Make and record observations and measurements using a range of methods for different investigations. • Apply mathematical concepts and calculate results. • Present observations and data using appropriate methods, including tables. • Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions. • Present reasoned explanations, including explaining data in relation to hypotheses. • Understand and use SI units. • Carry out appropriate calculations and undertake basic data analysis including simple statistical techniques.	world, alongside prior knowledge and experience. • Make predictions using scientific knowledge and understanding. • Plan and carry out the most appropriate types of scientific enquiries, including identifying independent, dependent and control variables, where appropriate. • Use appropriate techniques, apparatus and materials during fieldwork and laboratory work, paying attention to health and safety. • Make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements. • Apply mathematical concepts and calculate results. • Present observations and data using appropriate methods, including tables. • Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions. • Present reasoned explanations, including explaining data in relation to predictions and hypotheses. • Showing awareness of potential sources of random and systematic error. • Understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature.	evidence and ideas, together with the importance of publishing results and peer review • Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience • Make predictions using scientific knowledge and understanding • Select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate • Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety • Make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements • Apply mathematical concepts and calculate results • Present observations and data using appropriate methods, including tables and graphs • Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions

		• Carry out appropriate calculations and undertake basic data analysis including simple statistical techniques.	• Present reasoned explanations, including explaining data in relation to predictions and hypotheses • Showing awareness of potential sources of random and systematic error • Understand and use SI units • Undertake basic data analysis including simple statistical techniques.
Assessment	End of topic assessment	End of topic assessment	End of topic assessment
Summer Term	Biology	Chemistry	
Substantive Knowledge	Life Cycles • Reproduction in humans (as an example of a mammal), including the structure and function of the male and female reproductive systems, menstrual cycle (without details of hormones), gametes, fertilisation, gestation and birth, to include the effect of maternal lifestyle on the foetus through the placenta. • Reproduction in plants, including flower structure, wind and insect pollination, fertilisation, seed and fruit formation and dispersal, including quantitative investigation of some dispersal mechanisms. • Heredity as the process by which genetic information is transmitted from one generation to the next.	Materials • Properties of ceramics, polymers and composites (qualitative).	

	• A simple model of chromosomes, genes and DNA in heredity, including the part played by Watson, Crick, Wilkins and Franklin in the development of the DNA model. • Differences between species. • The variation between individuals within a species being continuous or discontinuous, to include measurement and graphical representation of variation.		
Disciplinary Skills	• Understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas. • Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience. • Plan and carry out the most appropriate types of scientific enquiries, including identifying independent, dependent and control variables, where appropriate. • Use appropriate techniques, apparatus and materials during fieldwork and laboratory work, paying attention to health and safety. • Make and record observations and measurements using a range of methods for different investigations. • Apply mathematical concepts and calculate results. • Present observations and data using appropriate methods, including tables.	• Pay attention to objectivity and concern for accuracy and precision. • Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience. • Make predictions using scientific knowledge and understanding. • Plan and carry out the most appropriate types of scientific enquiries, including identifying independent, dependent and control variables, where appropriate. • Use appropriate techniques, apparatus and materials during fieldwork and laboratory work, paying attention to health and safety. • Make and record observations and measurements using a range of methods for different investigations. • Apply mathematical concepts and calculate results. • Present observations and data using appropriate methods, including tables.	

	• Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions. • Present reasoned explanations, including explaining data. • Understand and use SI units and carry out appropriate calculations and undertake basic data analysis including simple statistical techniques.	• Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions. • Present reasoned explanations, including explaining data in relation to hypotheses. • Show awareness of potential sources of random error • Understand and use SI units. • Carry out appropriate calculations and undertake basic data analysis including simple statistical techniques.	
Assessment		End of topic assessment End of year exam assessing all Y7 topics	End of topic assessment End of year exam assessing all Y7 topics
Tier 3 Vocabulary	See key word sheet for each unit	See key word sheet for each unit	See key word sheet for each unit

Key Stage 3: Year 8 – Long Term Planning

Autumn term	Biology	Chemistry	Physics
Substantive Knowledge	The Body • Structure of the heart • Blood flow through the heart • Structure of the lungs • Air flow through the lungs • Lung adaptations • Structure and function of the digestive system • Lock and key theory on enzyme action • Food test positive results	Chemical Formulae • Chemical symbols and formulae • Naming compounds • Writing word and symbol equations • Basic Mr calculations	Electricity • Current • Insulators and conductors • Voltage- calculating voltage • Series and parallel circuits • Potential difference • Static electricity

Disciplinary Skills	Literacy: (i) development of vocab – see key word list; (ii) Gorilla hearts comprehension Numeracy: (i) Working scientifically: (i) make and record accurate observations; (ii) identifying independent, dependent and control variables as part of planning; (iii) identify risks in a planned activity. Practical skills: (ii) carry out practical procedures using instructions without guidance; (iii) observe and investigate reactions; (iv) use a measuring cylinder and thermometer correctly; (v) use indicators correctly to identify biological molecules	Literacy: (i) development of vocab – see key word list; (ii) writing word equations for chemical reactions. (iii) Compound or poison comprehension Numeracy: (i) calculation of formula masses, Mr. Working scientifically: (i) make and record accurate observations (ii) use observations to write word equations Practical skills: (i) use a Bunsen burner safely; (ii) carry out practical procedures using instructions without guidance; (iii) observe and investigate chemical reactions;	Literacy: (i) development of vocab – see key word list; (ii) write up of an investigation. Read newspaper articles about electricity and alternative power. Using literacy skills to conclude which electricity source would be more efficient etc. (iii) Benjamin Franklin comprehension Numeracy: (i) calculation of current and voltage across parallel and series circuit (basic maths) Collect data and input to a table, identify any outliers, calculate a mean Working scientifically: (i) make and record accurate observations; (ii) identifying independent, dependent and control variables as part of planning KMP; (iii) identify risks in a planned practical activity. Make predictions using scientific knowledge and understanding Practical skills: Using electricity equipment safely understanding risks and hazards associated with it, minimise risk throughout practical, identifying variables, record observations and measurements.
Assessment	The Body - knowledge based KMP	Chemical Formulae - knowledge based KMP	Electricity - knowledge based KMP Cumulative assessment 1 assessing Autumn Term units
Spring Term	Biology	Chemistry	Physics
Substantive knowledge	Healthy Living Difference between physical and mental health Factors that affect mental and physical health Healthy lifestyle Balanced diet Drugs, smoking and alcohol Malnutrition and obesity	Development of the Periodic Table What is an atom Periodic table development Properties and examples of metals and non-metals Allotropes of carbon and their use Alkali metals- reactivity and properties Group 7 properties and how they react	Waves Waves Intro Light Waves Refraction Colour Sound: formation, detection and use Wave Speed

Disciplinary skills	Literacy: (i) development of vocab – see key word list; (ii) write up of investigation (iii) An apple a day comprehension Numeracy: (i) calculation of calorie intake (ii)average HR and breathing rates Working scientifically: (i) make and record accurate observations Practical skills: (i) use of stopwatch; (ii) taking pulse rate	Literacy: (i) development of vocab – see key word list; (ii) Identifying and explaining of a trend, reading specific history articles and research about the developing periodic table and being able to draw conclusions based on evidence provided. (iii) Chain mail fabric comprehension Numeracy: Drawing graphs, ability to identify a trend, calculate outliers Working scientifically: (i) looking at how ideas/ theories develop over time with scientists working and learning from each other. Practical skills: (i) carry out practical procedures using instructions without guidance; (ii) observe and investigate chemical reactions;	Literacy: (i) development of vocab – see key word list; (ii) write up of an investigation (iii) The sound of thunder comprehension Numeracy: (i) calculating wave speed, measuring angles. Working scientifically: (i) make and record accurate observations; (ii) identifying independent, dependent and control variables as part of planning KMP; (iii) identify risks in a planned activity (KMP), interpreting wave properties, angles of incidence and reflection. Practical skills: (i) carry out practical procedures using instructions without guidance; (ii) record observations from microscopic images; iii) interpret observations and data to draw conclusions; iv) evaluate risks.
Assessment	Healthy Living knowledge based KMP	Development of the periodic table knowledge based KMP	Waves knowledge based KMP Cumulative assessment 2 assessing Spring Term units
Summer Term	Biology	Chemistry	Physics
Substantive Knowledge	Bioenergetics Fermentation Aerobic respiration Anaerobic respiration Photosynthesis Limiting factors	Materials /rock cycle Climate change Different types of rocks and their properties	Magnetism Magnets and magnetic materials How a magnet is made Magnetic field patterns Electromagnets
Disciplinary Skills	Literacy: (i) development of vocab – see key word list; (ii) Human photosynthesis comprehension Numeracy: (i) Working scientifically: (i) make and record accurate observations; (ii) identifying independent, dependent and control variables as	Literacy: (i) development of vocab – see key word list; (ii) write up of research from computers (iii) Old rocks comprehension Numeracy: (i) calculation of how long the project is going to take them. Managing time efficiently. Working scientifically: (i) make and record accurate observations of different rocks; (ii) be	Literacy: describe the Earth's magnetic field pattern (ii) Magnetic fields comprehension Numeracy: to be able to use a compass and link it to direction and measurements Working scientifically: (i) make and record accurate observations; (ii) identifying

	part of planning; (iii) identify risks in a planned activity. Practical skills: (ii) carry out practical procedures using instructions without guidance; (iii) observe and investigate reactions; (iv) use a microscope & slide correctly;	able to identify rocks and categorise them according to their correct type Practical skills: (i) Working as a team, developing a project where all in group participates. Produce a project and presenting confidently to the class.	independent, dependent and control variables as part of planning KMP; Practical skills: to be able to use a compass, to be able to plot magnetic field diagrams, to be able to make an electromagnet.
Assessment	Bioenergetics knowledge based KMP	Materials / rock cycle knowledge based KMP	Magnetism knowledge based KMP End of Year exam – assesses all Y8 content
Tier 3 Vocabulary	See key word sheet for each unit	See key word sheet for each unit	See key word sheet for each unit

The last topic studied in Year 8 (after the end of year exam), is called 'how science works'. This has no substantive knowledge but is aimed at improving skills such as those listed below:

1. Mean calculation
2. Use of keywords (see key word definition sheet), e.g. accuracy, reliability, validity.
3. Identify variables
4. Graph and results table plotting
5. Describing, explaining and evaluating data
6. Writing a scientific method
7. Writing hypotheses
8. Making conclusions on data and referring back to hypotheses.
9. Improving the accuracy, reliability and validity of data.
10. Planning investigations

Key Stage 4 -Year 9

Autumn term	Biology	Chemistry	Physics
Substantive Knowledge	**Cells and communicable diseases** • Eukaryotic and Prokaryotic cell structure comparison. • Role of each of the organelles: • Nucleus Cytoplasm Cell membrane Mitochondria Ribosomes Chloroplast • Vacuole • Cell wall & cellulose • Compare plant and animal cells • How cells are specialised to carry out a particular function: • Sperm cell Nerve cell Muscle cell Root hair cell Xylem Phloem • Importance of cell differentiation • How microscopy techniques have developed • How electron microscopy has increased understanding • Differences in magnification and resolution • Structure of the nucleus of the cell • What are communicable diseases • Examples of diseases caused by bacteria, virus, fungi and their symptoms. • Bodies first line of defence. • Disease transmission • Second line of defence – phagocytes • Third line of defence – lymphocytes • Antibodies and how they work • Immunity • Antibiotics and how they work • Painkillers and how they work	**Atomic structure and periodic table** • Atoms, elements, mixtures and compounds • Writing formulae of compounds • Separating mixtures – chromatography, crystallisation, distillation • Periodic table – organisation, history • Structure of the atom – history, models, isotopes and formation of ions • Electron arrangement and reactivity • Group 1 elements • Group 7 elements • Transition metals and noble gases	**Energy I and particles** • Energy resources • Calculating Energy efficiency • Calculating electrical power • Calculating electrical energy • Calculating work done • Calculating gravitational potential energy • Calculating Kinetic Energy • Calculating Elastic Energy • Particle Model • Density/ calculating density and core experiment on density • Internal energy • Gases and pressure • Brownian motion Boyles Law Pressure will be revisited in forces year 10/11

	• Drug testing stages • Blind and double bling trials. • Placebo's • Plant disease		
Disciplinary Skills	Literacy: Answering 6 mark questions. Numeracy: Scale calculations Magnification calculations Standard form Estimation of size Use a light microscope SA:V ratio's calculated and compared Calculate percentage gain and loss Measure rate Use percentages Measuring the area of a circle Working scientifically: Develop models and analogies to develop explanations of how cells divide. Evaluation of risks and benefits Practical skills: Recognise and draw images of cells Aseptic technique	Literacy: development of vocab – see KO words in bold; AO2/AO3 style GCSE questions/long answer Numeracy: calculating numbers of sub atomic particles recording data in a table Working scientifically: making and recording practical observations; writing equations; understand how theories have developed over time; recognise the importance of peer review; use a variety of models Practical skills: separating a variety of mixtures	Literacy: Understand Particle models Numeracy: Using equations Rearranging equations Converting units Applying knowledge of renewable energy to real-life situations. Calculating pressure Working scientifically: Measuring density of regular and irregular objects Understand what causes pressure Practical skills: Density required practical
Assessment	Cells and communicable diseases KMP (includes knowledge acquisition test) Formative assessment – 6-mark question	Atomic structure and periodic table KMP (which includes knowledge acquisition test) Formative assessment – 6-mark question	Energy I and particles KMP (which includes knowledge acquisition test) Formative assessment – 6-mark question

Spring Term	Biology	Chemistry	Physics
Substantive knowledge	<u>Supplying the cell and body systems</u> In this section 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. 4.1.3.1 Diffusion 4.1.3.3 Active transport 4.2.1 Principles of organisation	<u>What is it made of?</u> Difference between pure/impure substances What a formulation is and how they are important in everyday life Principles and uses of chromatography- inc. RP Identification of common gases- Carbon dioxide, hydrogen, oxygen and chlorine. What is conservation of mass, Conservation of mass in chemical equations and how this relates to balanced symbol equations How to calculate relative formula mass How to calculate percentage mass	<u>Elec and Magnetism</u> Circuit symbols Electric current How resistance affects current I-V characteristics and ohmic conductors Like poles repel, unlike poles attract Magnetic field lines Permanent and temporary magnets Strength and shape of a magnetic field Electromagnets
Disciplinary skills	<u>Literacy:</u> HW literacy task – girl born with no blood New vocab linked to each system – knowledge organisers and key word list available. <u>Numeracy:</u> calculation of surface area to volume ratio Graph plotting rate calculations (enzyme required practical) <u>Working scientifically:</u> <u>Required practical</u> 1. <u>Food tests</u> – analysing data and interpreting results, working safely 2. <u>Enzymes</u> – identifying variables, planning an investigation, analysis and evaluation of results	<u>Literacy:</u> Interpreting a method, comparison of formulations. Development of vocab- see key words on knowledge organiser. Opportunity for AO2/AO3 style GCSE questions <u>Numeracy:</u> Measuring from a thermometer- potential purity practical Addition when calculating relative formula mass Calculating percentages Division when calculating rf values Measuring using a ruler/changing units when identifying distances moved by substance/solvent	Literacy: Numeracy: plotting graphs, linear relationships, calculations of current, voltage and resistance. Working scientifically: Practical skills – use a plotting compass to map a magnetic field

		Recognise importance of scientific quantities and understand how they are determined Writing equations Using appropriate significant figures in answers <u>Working scientifically:</u> Developing a method to determine if the formulation for a substance really does matter. <u>Practical skills:</u> Chromatography required practical Formulations practical Use balance to prove conservation of mass where no reactants or products are gases in a closed system.	
Assessment	Supplying the cell and body systems - KMP (includes knowledge acquisition test) Formative assessment – 6-mark question	'What is it made of?' - KMP (includes knowledge acquisition test) Formative assessment – 6-mark question	Electricity and magnetism - KMP (includes knowledge acquisition test) Formative assessment – 6-mark question
Summer Term	Biology	Chemistry	Physics
Substantive Knowledge		<u>The Earth's atmosphere</u> Evolution of the atmosphere Composition of the atmosphere Greenhouse gases and the greenhouse gas effect Climate change Carbon footprint Complete and incomplete combustion Atmospheric pollutants	<u>Forces I</u> Scalar and vector quantities Contact and non-contact forces Weight and gravitational fields Calculating the weight of an object Resultant force Definition of a joule Work done and energy transfer Calculating the work done when a force moves an object Thinking distance, braking distance and stopping distances. Reaction times and thinking distance Braking distance Energy transfers when stopping

Disciplinary Skills		Balance equations for combustion Use evidence and graphs to conclude information using and finding reputable scientific resources about climate change have an understanding about the world around them and how the atmosphere has changed	Literacy Numeracy: calculations; use of calculator, rearranging equations Working scientifically: use of units Practical skills
Assessment	End of Year 9 exam	The Earth's atmosphere KMP (includes knowledge acquisition test) Formative assessment – 6-mark question	Forces I KMP (includes knowledge acquisition test) Formative assessment – 6-mark question
Tier 3 Vocabulary	See key words on the knowledge organiser for each unit	See key words on the knowledge organiser for each unit	See key words on the knowledge organiser for each unit

Key Stage 4 Year 10 –AQA GCSE Combined Science Trilogy (new for 2025-2026 Y10)

	Biology	Chemistry	Physics
Substantive Knowledge	Plants Be able to recall the word and balanced symbol equations for photosynthesis. Be able to describe photosynthesis as an endothermic reaction. Be able to explain the effects of temperature, light intensity, carbon dioxide concentration, and the amount of chlorophyll on the rate of photosynthesis. Be able to measure and calculate rates of photosynthesis. Be able to extract and interpret graphs of photosynthesis rate involving one limiting factor. Be able to explain how to carry out a valid investigation into the effect of light intensity on the rate of photosynthesis in pondweed.	Structures and bonding • 3 types of bonding: covalent, ionic and metallic • Small covalent, giant covalent, ionic and metallic substances and their properties • Solids, liquids and gases • Changes of state • Carbon allotropes Chemical reactions • Predictions • Complex reactions Students learn that experimenting with chemical reactions in a systematic way and organizing their results logically.	Energy and particles 2 Specific heat capacity Internal energy Specific latent heat Energy and power Elec and Mag 2 Ohm's Law Resistance current and potential difference Series and parallel circuits Resistors in series Parallel circuits Resistors in parallel circuits Domestic uses and safety Alternating and direct potential difference Mains electricity supply Wiring a plug

	(Higher) Be able to explain when factors limit the rate of photosynthesis. (Higher) Be able to explain when two variables on a graph or table are inversely proportional. (Higher) Be able to explain how knowledge of limiting factors helps enhance the conditions of a greenhouse to optimise the rate of photosynthesis and maximise profit. Be able to explain that plants also need nitrates to make proteins for growth and repair. **Animal health and respiration** Cellular respiration as an exothermic reaction which is continuously occurring in living cells. During exercise the body responds to an increased demand for energy. Metabolism as the sum of all chemical reactions in the body. The energy transferred by respiration in cells is used by the organism for the continual enzyme-controlled processes of metabolism that synthesise new molecules. In coronary heart disease layers of fatty material build up inside the coronary arteries, narrowing them. This reduces the flow of blood through the coronary arteries, resulting in a lack of oxygen for the heart muscle. Stents are used to keep the coronary arteries open. Statins are widely used to reduce blood cholesterol levels which slows down the rate of fatty material deposit.	Students learn about the reaction of metal with oxygen and acids. Students learn about the reaction of metal oxide and metal carbonates acids. Students learn about new materials and processes. Understand the complex reactions that take place in living organisms. The extraction of important resources from the earth. The pH scale = 0 – 14, colours · Acid = H+, alkalis = OH- · Strong and weak acids (HT only) Acid + metal à salt + hydrogen – word/balanced symbol equations · Oxidation/reduction in terms of electrons (HT only) · Ionic equations (HT only) H+ + OH- → H2O · Acids are neutralised by alkalis, bases and carbonates – word/balanced symbol equations · Deduce formula of salts Recap conservation of mass · Moles (HT only) · Reacting mass calculations (HT only) Exothermic = reaction heats up, energy is released to the surroundings · Endothermic = reaction cools down, energy is absorbed from the surroundings Reaction profiles showing exothermic/endothermic reactions Bond energy calculations (HT only) **Extraction of metals** The reactivity series Corrosion of metals / rusting of iron (Triple only) Displacement reactions Extracting metals Electrolysis Aluminium extraction	Energy transfers Work done when charge flows National grid Static electricity Electrostatic forces between objects. Electric fields and the forces exerted by objects placed into an electric field. **Atomic structure** Structure of an atom How to handle radioactive sources safely to avoid contamination The process and uses of irradiation. Safety precautions taken when dealing with radioactive sources. The radioactive decay of an unstable element. Activity is measured in Becquerel (Bq). The nature of different types of nuclear radiation. Nuclear decay equation Models of the atom Randomness and half life Background radiation Using Alpha Beta and Gamma Hazards **Forces 2** Elasticity Pressure Students learn about work done and energy transfer. They will investigate Forces and elasticity. They will also study pressure in a fluid and atmospheric pressure. Speed

	Cells divide in a series of stages called the cell cycle. Students should be able to describe the stages of the cell cycle, including mitosis. Students should be able to explain how vaccination will prevent illness in an individual, and how the spread of pathogens can be reduced by immunising a large proportion of the population. Vaccination involves introducing small quantities of dead or inactive forms of a pathogen into the body to stimulate the white blood cells to produce antibodies. If the same pathogen re-enters the body the white blood cells respond quickly to produce the correct antibodies, preventing infection. Biology only - Monoclonal antibodies are produced from a single clone of cells. Students should describe how they are produced and used. **Biotechnology** Biotechnology is only mentioned explicitly in the specification for Biology but by linking these ideas together students will develop a greater understanding of the applications of biology and putting it into context may help with application style exam questions. From spec: Role of biotechnology (Biology) - Students should be able to describe and explain some possible biotechnical and agricultural solutions to the demands of the growing human population. Anaerobic respiration in plant and yeast cells is represented by the equation: glucose ethanol +	Metal extraction including biological methods (H tier only) Life cycle assessments (LCA) and recycling Renewable resources	Distance time graphs Velocity time graphs Acceleration Equations of motion for uniform acceleration. **Waves 1** Features of transverse and longitudinal waves Properties of waves. Equation linking the wave speed, frequency and wavelength should be known. Electromagnetic spectrum Properties of electromagnetic waves Radio waves and electrical circuits. How electromagnetic waves are generated. The effects of gamma rays, X-rays and ultraviolet waves on the body. Uses of electromagnetic waves **Space (triple only)** Solar system Stability of orbital motions Satellites Red shift

	carbon dioxide Anaerobic respiration in yeast cells is called fermentation and has economic importance in the manufacture of bread and alcoholic drinks Modern biotechnology techniques enable large quantities of microorganisms to be cultured for food. The fungus Fusarium is useful for producing mycoprotein, a protein-rich food suitable for vegetarians. The fungus is grown on glucose syrup, in aerobic conditions, and the biomass is harvested and purified. Students should be able to explain how temperature, water and availability of oxygen affect the rate of decay of biological material. Gardeners and farmers try to provide optimum conditions for rapid decay of waste biological material. The compost produced is used as a natural fertiliser for growing garden plants or crops. Anaerobic decay produces methane gas. Biogas generators can be used to produce methane gas as a fuel. A stem cell is an undifferentiated cell of an organism which is capable of giving rise to many more cells of the same type, and from which certain other cells can arise from differentiation. Treatment with stem cells may be able to help conditions such as diabetes and paralysis. Meristem tissue in plants can differentiate into any type of plant cell, throughout the life of the plant. Stem cells from meristems in plants can be used to produce clones of plants quickly and economically		

	Evolution Causes of variation How evolution by natural selection works The work of Charles Darwin Formation of fossils How fossils provide evidence for evolution How antibiotic-resistant bacteria provide evidence for evolution Reasons for extinction Types of adaptations Linnaean classification Three-domain classification **Ecology** • Abiotic and biotic factors • Adaptation • Decomposition • Biodiversity Students learn about communities and levels of organization. Students learn about adaptations how they help organisms survive. Students study how materials are cycled and decomposition. They will look at waste management, land use, deforestation and revisit global warming. Students learn about the importance of biodiversity and maintaining biodiversity.		
Disciplinary Skills	**Required practical - Photosynthesis** • Make observation and drawing of a transverse section of leaf.	**Required practical - Preparation of a pure, dry sample of a soluble salt** • Investigate pH changes when a strong acid neutralises a strong alkali.	**Required practical - Resistance of a wire** • Translate information between graphical and numeric form.

	• Process data from investigations involving stomata and transpiration rates to find arithmetic means. • Use different sampling techniques and calculate surface areas and volumes. Solve simple algebraic equations. Required practical - Field investigations • Use of apparatus, recording measurements • Safe and ethical use of a living organisms (plants or animals) • Use sampling techniques to study distribution and abundance of organisms. • Develop hypotheses. • Plan experiments to test hypotheses. • Use of transects and quadrats. • Estimates of population size. • Understand principles of sampling. • Use mean, mode and median. Plot and draw appropriate graphs. Biology only Required practical activity 10: investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change.	• Recognise and use expressions in decimal form. • Use ratios, fractions and percentages. • Make estimates of the results of simple calculations. • Translate information between graphical and numeric form. • Mixing of reagents to explore chemical changes and/or products. Required practical - Electrolysis • Safe use of a range of equipment to separate chemical mixtures. • Explain how testing a prediction can support or refute a new scientific idea. Required practical - Exothermic and Endothermic reaction investigation • Drawing and interpreting appropriate graphs from data to determine rate of reaction. • Plot two variables from experimental or other data. • Determine the slope and intercept of a linear graph. • Draw and use the slope of a tangent to a curve as a measure of rate of change	Required practical - Investigate I–V characteristics of a variety of circuit elements • Assess danger from different radioactive sources. • Model half-life • Draw half-life graphs Required practical - Force and extension • Plan experiments or devise procedures. • Carry out experiments with correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. • Translate data from one form to another. • Plot two variables from experimental or other data • Carry out and represent mathematical and statistical analysis. • Use an appropriate number of significant figures in calculation. Required practical – Acceleration • Use apparatus and techniques to measure motion. • Develop hypotheses. • Evaluate methods and suggest possible improvements. • Present and interpret observations and data. • Present reasoned explanations including relating data to hypotheses. • Use SI units. Required practical – Waves • Use of appropriate apparatus

			• Present observations and other data using appropriate methods.
Assessment	Each unit has an end of unit test made up of past GCSE questions. Cumulative assessment 1 – November assesses Y9 content Cumulative assessment 2 – March assesses Plants, animal health and respiration and biotechnology End of Year 10 exam – complete paper 1 Formative assessment – 6-mark question for each unit	Each unit has an end of unit test made up of past GCSE questions. Cumulative assessment 1 – November assesses Y9 content Cumulative assessment 2 – March assesses Structure and bonding and chemical reactions End of Year 10 exam – complete paper 1 Formative assessment – 6-mark question for each unit	Each unit has an end of unit test made up of past GCSE questions. Cumulative assessment 1 – November assesses Y9 content Cumulative assessment 2 – March assesses energy and particles 2, elec and Mag 2 and atomic structure End of Year 10 exam – complete paper 1 Formative assessment – 6-mark question for each unit
Tier 3 Vocabulary	See key words on the knowledge organiser for each unit	See key words on the knowledge organiser for each unit	See key words on the knowledge organiser for each unit

Key Stage 4: Year 11 – Long Term Planning - AQA GCSE Combined Science Trilogy

	Biology	Chemistry	Physics
Substantive Knowledge	**Ecology** • Abiotic and biotic factors • Adaptation • Decomposition • Biodiversity Students learn about communities and levels of organization. Students learn about adaptations how they help organisms survive. Students study how materials are cycled and decomposition. They will look at waste management, land use, deforestation and revisit global warming. Students learn about the importance of biodiversity and maintaining biodiversity. **Homeostasis and response** • Nervous system • Glucose • Hormones Students learn about the human endocrine system and the importance of homeostasis. Students learn the structure and function of the nervous system. Students learn about the control of blood glucose concentration and diabetes. Students study hormones in human reproduction and contraception. **Higher tier - The use of hormones to treat infertility. Negative feedback.**	**Organic chemistry** • Fossil Fuels • Distillation • Hydrocarbons • Alkenes and polymerisation Students learn about the process of fossil fuel formation. The naming systems for alkanes and alkenes. Students build on their knowledge of separation techniques and look at the fractional distillation process. Students learn to describe the patterns in the fractions from crude oil in terms of flammability, boiling point, colour and viscosity. Students study the properties and structures of hydrocarbons – Alkanes and Alkenes. Students learn about the cracking process including the conditions. **Chemical analysis** • Formulations • Chromatography Students learn about pure substances and define formulations. Students study chromatography and gas tests. They will complete gas test for hydrogen, oxygen and carbon dioxide. Students will also learn about tests for chlorine gas. **Chemistry of the Earth's Atmosphere** • Composition and change • Pollutants	**Forces and motion** • Scalars and vectors • Motion change • Pressure • Newton's Laws • Momentum Students learn about scalar and vector quantities. Students identify examples of contact and non-contact forces. Students learn about gravity, balanced and unbalanced and they develop their ability to draw forces diagrams. Students will use force diagrams to calculate resultant force and predict motion changes. Students learn to describe motion along a line and calculate. Students draw and interpret distance-time graphs and speed time graphs. Students will measure acceleration and factors effecting it. Students learn Newton's Laws of motion and factors affecting braking distance and stopping distance. **Higher tier - Momentum is a property of moving objects. Conservation of momentum. Pressure in a fluids.** **Waves** • Properties • Emission and absorption Students learn about examples of transverse and longitudinal waves. They will study the properties of waves.

		Students learn about the composition of the Earth's atmosphere and how it has changed. They will revisit oxygen production and photosynthesis, carbon dioxide the role plants play in reducing the level in the atmosphere. Students learn about the greenhouse gases and climate change. Students learn about their carbon footprint and its reduction. Using the Earth's resources • Classification • Water Treatment Students learn to identify resources required for life on Earth. Resources will be classified as finite/renewable/sustainable. Students learn about potable water and water treatment methods. Students study the Life cycle assessment and carry them out. They will also look at ways of reducing the use of resources. **Higher tier - Alternative methods of extracting metals.**	Students learn about types of electromagnetic waves, their properties and the uses and applications of electromagnetic waves. Students will investigate the emission and absorption of infrared radiation. Magnets and Electromagnets • Poles • Fields • Electromagnetism Students learn about the poles of a magnet, magnetic fields and how to view them. Students learn about the movement of poles within a magnetic field. Students investigate factors affecting electromagnetism. **Higher tier - Fleming's left-hand rule, Electric motors.**
Disciplinary Skills	**Required practical - Reaction time, Variables** • Use of apparatus, recording measurements. • Safe and ethical use of a living organisms (plants or animals). • Translate data into graphs. **Required practical - Field investigations** • Use of apparatus, recording measurements • Safe and ethical use of a living organisms (plants or animals) • Use sampling techniques to study distribution and abundance of organisms.	**Required practical - Water Purification** • Use of appropriate apparatus • Measurement of pH in different situations. • Draw conclusion from data collected. • Separate chemical mixtures including. evaporation/distillation and chromatography • Safe use of appropriate heating devices. **Required practical – Chromatography** • Separate chemical mixtures including. evaporation/distillation and chromatography • Record a range of measurements accurately.	**Required practical – Acceleration** • Use apparatus and techniques to measure motion. • Develop hypotheses. • Evaluate methods and suggest possible improvements. • Present and interpret observations and data. • Present reasoned explanations including relating data to hypotheses. • Use SI units. **Required practical – Waves**

	• Develop hypotheses. • Plan experiments to test hypotheses. • Use of transects and quadrats. • Estimates of population size. • Understand principles of sampling. • Use mean, mode and median. • Plot and draw appropriate graphs.		• Use of appropriate apparatus Present observations and other data using appropriate methods.
Assessment	Each unit has an end of unit test made up of past GCSE questions. Formative assessment – 6-mark question for each unit Cumulative assessment 1 – paper 1 mock Cumulative assessment 2 – paper 2 mock GCSE exams	Each unit has an end of unit test made up of past GCSE questions. Formative assessment – 6-mark question for each unit Cumulative assessment 1 – paper 1 mock Cumulative assessment 2 – paper 2 mock GCSE exams	Each unit has an end of unit test made up of past GCSE questions. Formative assessment – 6-mark question for each unit Cumulative assessment 1 – paper 1 mock Cumulative assessment 2 – paper 2 mock GCSE exams
Tier 3 Vocabulary	See key words on the knowledge organiser for each unit	See key words on the knowledge organiser for each unit	See key words on the knowledge organiser for each unit

Appendix – Key Stage 4 Vocabulary and Key Terms - Definitions

Years 10/ 11 GCSE Biology

The additional parts are taught within the unit that they are in and are as follows:

- B3 – monoclonal antibodies, plant disease
- B5 – brain, the eye, control of body temperature, hormone responses in plants
- B6 sexual vs asexual reproduction in plants, DNA and mutations, theories of evolution
- B7 decay and required practical, trophic levels in an ecosystem, food production

Years 10/11 Chemistry

The additional parts are taught within the unit that they are in and are as follows:

- C2 - nanotechnology
- C3 – atom economy and % yield, using concentrations of solutions and titration required practical
- C4 – titrations
- C5 – chemical cells and fuel cells
- C7 – reactions of alkenes and alcohols, synthetic and naturally occurring polymers
- C8 – identification of ions by analysis and instrumental techniques
- C10 – using materials, the Haber process and the use of NPK fertilisers

Years 10/11 Physics

The additional parts are taught within the unit that they are in and are as follows:

- Electricity – static electricity
- Particle model – pressure
- Atomic structure - hazards and uses of radioactive emissions and background radiation, fission and fusion
- Forces – moments, forces and gears, pressure and pressure differences in fluid, velocity-time graphs, momentum
- Waves – some parts of waves in air, fluids and solid, convex and concave lenses,
- Magnetism and electromagnetism – interpret diagrams of electromagnetic devices, induced potential, the National grid and transformers
- Space – the whole unit! Solar system, stability of orbital motions, satellites and red shift

Key Stage 5

- AQA Biology – well established
- AQA Chemistry – new for current Y12 (2024)
- Edexcel Chemistry – only for Y13
- AQA Physics – third year of following this specification

In terms of skills – all three science A levels have core practical, and skills are assessed in these practicals. Being able to do all the practical skills competently means that students gain a practical endorsement.

<table>
<tr><th></th><th>Biology</th><th>Chemistry</th><th>Physics</th></tr>
<tr>
<td>Substantive Knowledge</td>
<td>YEAR 12
Biological molecules
• Monomers and polymers
• Carbohydrates
• Lipids
• Proteins
• Many proteins are enzymes/nucleic acids
• DNA replication
• ATP
• Water
• Inorganic ions

Cells
• Cell structure
• All cells arise from other cells
• Transport across cell membranes
• Cell recognition and the immune system

Organisms exchange substances with their environment
• Surface area to volume ratio
• Gas exchange
• Digestion and absorption
• Mass transport in animals
• Mass transport in plants

Genetic information, variation and relationships between organisms
• DNA, genes and chromosomes</td>
<td>YEAR 12
Atomic structure
• Fundamental particles
• Mass number and isotopes
• Electronic configuration
• Ionisation energy
Bonding
• Ionic bonding
• Nature of covalent and dative covalent bonding
• Metallic bonding
• Bonding and physical properties
• Shapes of simple molecules and ions
• Bond polarity
• Forces between molecules

Amount of substance
• Relative atomic mass and relative molecular mass
• The mole and Avogadro’s constant
• The ideal gas equation
• Empirical and molecular formulae
• Balanced equations and associated calculations
Kinetics
• Collision theory
• Maxwell Boltzmann distribution
• Effect of temperature on reaction rate
Introduction to organic chemistry
• Nomenclature
• Reaction mechanisms</td>
<td>YEAR 12
<table>
<tr><th>Spec code</th><th>Teacher A</th><th>Teacher</th></tr>
<tr><td>3.1

3.2.1</td><td>Measurements and their errors
Matter and radiation</td><td>A</td></tr>
<tr><td>3.3.1</td><td>Waves</td><td>B</td></tr>
<tr><td>3.2.1</td><td>Quarks and Leptons</td><td>A</td></tr>
<tr><td>3.3.1</td><td>Waves</td><td>B</td></tr>
<tr><td>3.3.2</td><td>Quantum Phenomena</td><td>A</td></tr>
<tr><td>3.3.2</td><td>Optics</td><td>B</td></tr>
<tr><td>3.4.2</td><td>Materials</td><td>A</td></tr>
<tr><td>3.4.1</td><td>Mechanics</td><td>B</td></tr>
<tr><td>3.5</td><td>Electricity</td><td>A</td></tr>
<tr><td>3.4.1</td><td>Mechanics</td><td>B</td></tr>
<tr><td>
3.6.1
3.6.2</td><td>Start year 13 content
Simple Harmonic Motion
Thermal Physics</td><td>A</td></tr>
<tr><td>3.6.1
3.7.2</td><td>Start year 13 content
Circular Motion
Gravitational fields</td><td>B</td></tr>
</table>
</td>
</tr>
</table>

	• DNA and protein synthesis • Genetic diversity • Adaptation • Species and taxonomy • Biodiversity • Investigating diversity	• Isomerism Chemical equilibria • Chemical equilibria and Le Chatelier's Principle • Equilibrium constant, Kc, for homogeneous systems Alkanes • Fractional distillation of crude oil • Modification of alkanes by cracking • Combustion of alkanes • Chlorination of alkanes Oxidation, reduction and redox equations • Oxidation numbers • Redox equations Halogenoalkanes • Nucleophilic substitution • Elimination • Ozone depletion Group 2 • Chemical and physical properties • Uses Group 7 • Trends in properties • Use of chlorine and chlorate (I) Alkenes • Structure , bonding and reactivity • Addition reactions of alkenes • Addition polymers Alcohols • Alcohol production • Oxidation of alcohols • Elimination	

		• Energetics • Enthalpy change • Calorimetry • Application of Hess's Law • Bond enthalpies Organic analysis • Identification of functional groups by test tube reactions • Mass spectrometry • Infra red spectroscopy	
Disciplinary Skills	Required practical 1 Investigation into the effect of a named variable on the rate of an enzyme-controlled reaction. Required practical 2 Preparation of stained squashes of cells from plant root tips; set up and use of optical microscope to identify the stages of mitosis in these stained squashes and calculation of a mitotic index. Required practical 3 Production of a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue. Required practical 4 - Investigation into the effect of a named variable on the permeability of cell-surface membranes. Maths skills – magnification calculations Diagram drawing Maths skills – eye piece graticules and measuring cells.	Required practical 1 Make up a volumetric solution and carry out a simple acid base titration. Required practical 3 Investigation of how the rate of reaction changes with temperature Required practical 4 Carry out simple test-tube reactions to identify: • cations – Group 2, NH_4^+ • anions – Group 7 (halide ions), OH^- , CO_3^{2-},SO_4^{2-} Required practical 2 Measurement of an enthalpy change Required practical 5 Distillation of a product from a reaction Required practical 6 Test for alcohol, aldehyde, alkene and carboxylic acid	• develop and demonstrate a deep appreciation of the skills, knowledge and understanding of scientific methods • develop competence and confidence in a variety of practical, mathematical and problem solving skills Required practical 1 Investigation into the variation of the frequency of stationary waves on a string with length, tension and mass per unit length of the string. Required practical 2 Investigation of interference effects to include the Young's slit experiment and interference by a diffraction grating. Required practical 3 Determination of g by a free-fall method. Required practical 4 Determination of the Young modulus by a simple method.

	Conclusions and interpretation writing. **Required practical 5** Dissection of animal or plant gas exchange or mass transport system or of organ within such a system. **Required practical 6 –** Use of aseptic techniques to investigate the effect of antimicrobial substances on microbial growth. **Maths skills – statistics and standard deviation** **Dissection techniques** **Required practical 12 –** Investigation into the effect of a named environment factor on the distribution of a given species. **Writing up investigative work** **Field work** **Maths – statistics, energy transfer calculations** **Revision techniques**		**Required practical 5** Determination of resistivity of a wire using a micrometer, ammeter and voltmeter **Required practical 6** Investigation of the emf and internal resistance of electric cells and batteries by measuring the variation of the terminal pd of the cell with current in it. **Required practical 7** Investigation into simple harmonic motion using a mass–spring system and a simple pendulum.
Assessment	Centre assessments every two weeks assessing work completed over that time period. Formal cumulative assessments every half term one for each teacher. Mock assessments	10 cumulative assessments throughout the year, with complete AS mocks sat in the Y12 exam week	Assessments throughout the year. End of year exams AS papers

<table>
<tr><th></th><th>Biology</th><th>Chemistry</th><th>Physics</th></tr>
<tr>
<td>Substantive Knowledge</td>
<td>YEAR 13
Energy transfers in and between organisms
• Photosynthesis
• Respiration
• Energy and ecosystems
• Nutrient cycles

Organisms respond to changes in their internal and external environments
• Survival and response
• Receptors
• Control of heart rate
• Nervous coordination
• Homeostasis

Genetics, populations, evolution and ecosystems
• Inheritance
• Populations
• Speciation

The control of gene expression
• Gene expression
• Using genome projects
• Gene technologies</td>
<td>YEAR 13
Rate equations
• Determination of the rate equation

Thermodynamics
• Born Haber Cycles
• Gibbs free energy change and entropy change

Equilibrium constant Kp

Acids and bases
• pH
• ionic product of water
• weak acids and bases
• pH curves, indicators and titration curves
• Buffer action

Optical isomers

Aldehydes and ketones

Carboxylic acids and their derivatives

Electrode potential and electrochemical cells

Aromatic chemistry
• Bonding
• Electrophilic substitution
Amines
• preparation
• base properties</td>
<td>YEAR 13
<table><tr><th>Spec code</th><th>Teacher A</th><th>Teacher</th></tr><tr><td>3.6.2
3.6.2</td><td>Thermal Physics
Gases</td><td>A</td></tr><tr><td>3.7.2
3.7.3</td><td>Gravitational Fields
Electric Fields</td><td>B</td></tr><tr><td>3.8.1</td><td>Radioactivity</td><td>A</td></tr><tr><td>3.7.4
3.7.5</td><td>Capacitors
Magnetic Fields</td><td>B</td></tr><tr><td>3.8.1</td><td>Nuclear Energy</td><td>A</td></tr><tr><td>3.7.5</td><td>Electromagnetic Induction</td><td>B</td></tr><tr><td>3.12.2

3.12.3</td><td>Wave particle Duality
Special Relativity</td><td>A</td></tr><tr><td>3.12.1</td><td>Discovery of the electron</td><td>B</td></tr></table></td>
</tr>
</table>

		• nucleophilic properties Polymers • Condensation • Disposal Transition metals Reaction of ions in aqueous solutions Amino acids, proteins and DNA Organic analysis • Nuclear magnetic resonance spectroscopy • Chromatography Organic synthesis Properties of period 3 elements and their oxides	
Disciplinary Skills	Required practical 7 Use of chromatography to investigate the pigments isolated from leaves of different plants e.g. leaves from shade-tolerant and shade intolerant plants or leaves of different colours Required practical 8 Investigation into the effect of a named factor on the rate of dehydrogenase activity in extracts of chloroplasts Required practical 9 Investigation into the effect of a named variable on the rate of respiration of cultures of single-celled organisms	Required practical 7 Measuring the rate of a reaction by an initial rate method by a continuous monitoring method. Required practical 8 Measuring the EMF of an electrochemical cell Required practical 9 Investigate how the pH changes when a weak acid reacts with a strong base and when a strong acid reacts with a weak base. Required practical 10 Preparation of a pure organic solid and test its purity, and preparation of a pure organic liquid.	Required practical 7 Investigation into simple harmonic motion using a mass–spring system and a simple pendulum. Required practical 8 Investigation of Boyle's (constant temperature) law and Charles's (constant pressure) law for a gas. Required practical 9 Investigation of the charge and discharge of capacitors. Analysis techniques should include log-linear plotting leading to a determination of the time constant RC. Required practical 10 Investigate how the force on a wire varies with flux density, current and length of a wire using a top pan balance.

	Required practical 10 Investigation into the effect of an environmental variable on the movement of an animal using either a choice chamber or a maze Required practical 11 Production of a dilution series of a glucose solution and use of colorimetric techniques to produce a calibration curve with which to identify the concentration of glucose in an unknown urine sample. Maths skills – rate of reaction calculations Diagram drawing Conclusions and interpretation writing. Application	Required practical 11 Carry out simple test tube reactions to identify transition metal ions in aqueous solution. Required practical 12 Separation of a species by thin layer chromatography.	Required practical 11 Investigate, using a search coil and oscilloscope, the effect on magnetic flux linkage of varying the angle between a search coil and magnetic field direction. Required practical 12 Investigation of the inverse-square law for gamma radiation.
Assessment	Centre assessments every two weeks assessing work completed over that time period. Formal cumulative assessments every half term one for each teacher. Mock assessments	10 cumulative assessments throughout the year, with complete AS mock sat at end of September, with mocks for A level in January.	Assessments throughout the year. Biweekly knowledge tests on Y12 content AS mock end of September and A level mocks January.