

Science End Points: By the end of each year, students will be able to explain...

Year	Biology (Substantive Knowledge)	Chemistry (Substantive Knowledge)	Physics (Substantive Knowledge)	How Science Works (Disciplinary Knowledge)
7	...how organisms are classified, how they interact with each other and their environments, and the organisation and structure of all living things (cells, tissues, organs, organ system) and how living things reproduce.	...how atoms are arranged as elements (on the periodic table), compounds, or mixtures and the different ways to separate them. ...the difference between acids and alkalis, pH scale and neutralisation (including examples and applications)	...how energy is stored and transferred, including mechanically as sound ...the difference between contact and non-contact forces ...the structure and the solar system and the importance of gravity	The disciplinary knowledge is mainly taught through a substantive context. As pupils progress through the key stages the context of the substantive knowledge become more demanding and the level of support decreases until pupils are confident and independent. Different pupils will achieve this at different points through their science education and it is the class teacher's responsibility to scaffold the disciplinary and substantive knowledge appropriately. At the start of Year 7 pupils are taught the key skills needed to access the substantive knowledge for example... ...how to be safe in a laboratory (risk assessing) ...how to take accurate measurement using scientific equipment ...how to use a Bunsen burner for heating (including safety flame) ...how to record and present information (tables and graphs) collected from observations ...how to write a conclusion and an evaluation In Year 7 pupils will be introduced to the different aspects of a scientific investigation (identifying patterns, using secondary sources, carrying out an investigation, observing over time, identifying, classifying and grouping) and are introduced to the key concepts of accuracy and precision. Pupils will be given hypotheses and develop the ability to predict outcomes (write predictions) based upon their existing scientific knowledge. They be able to identify, with support, key variables; independent, dependent and main control variables, and follow a simple written procedures, making simple observations and taking measurements using apparatus provided. Pupils will record data in pre-prepared tables and present data as simple charts (scaffolded approach using pre-drawn scales and modelling via Visualiser as appropriate). Pupils will also be introduced to writing scaffolded conclusions (A.P.E. Answer, Pattern, Examples) based upon observations and measurements. In Year 8 pupils will build upon Working Scientifically from Year 7. They will use hypotheses and write predictions based upon their scientific knowledge and identify the independent, dependent variable and key control variables. Pupils will be able, with support, to construct their own tables including headings, appropriate units and number of repeats. Pupils will start to appreciate the importance of repeated readings and with support, carry out simple statistical analyses such as calculating mean averages to improve accuracy. Pupils will also be introduced to different types of error (systematic and random). Pupils will develop their used of complex data handling skills; identifying anomalies in their results. Pupils will use their results to write conclusions (scaffolding provided and withdrawn over time as required) and, with support, begin to evaluate results and methods. In Year 9 pupils will continue to build upon Working Scientifically from Year 7 and 8. Pupils will be able to independently identify variables in an investigation and formulate their own predictions based on existing subject knowledge. Pupils will be able to follow written procedures selecting the most appropriate equipment to use for a given context and construct their own tables (choosing appropriate headings, units and number of repeats) to record their observations and / or measurements. Pupils will be able to identify the most suitable chart or graph to present their data; xy-scatter graph with line of best fit for continuous data and bar charts for discontinuous data. Pupils will be able to independently write conclusions using the A.P.E.E. structure (Answer, Pattern, Example and Explanation) and, with guidance and scaffolding as appropriate, write evaluations based upon results, identifying anomalies and suggest improvements to the procedure followed.
8	...how different cells can lead to disease ...the impact of lifestyle upon health and ways to improve health (balanced diet) ...the differences between organisms (environmental and genetic) which can lead to evolution or extinction	...the interaction between matter in terms of chemical reactions and how these reactions can impact the atmosphere (climate change and composition of the atmosphere)	...how energy can be transferred and used in terms of light and electricity (generation, non-renewable and renewable), ...how forces are involved in motion, pressure, and magnetism	
9	...the differences between prokaryotic and eukaryotic cells, the movement of particles across cell membranes in animals and plants, how organisms defend themselves against diseases and infections, and where the energy comes from for all the biological processes (photosynthesis and respiration), plant physiology.	...the different models of the atom, the arrangement of elements in the periodic table and electron configuration ...the different types of separation techniques (including filtration, evaporation, crystallisation, simple distillation, fractional distillation and chromatography) ...different types of chemical reaction including neutralisation, exothermic, endothermic, making salts oxidation and reduction and the factors which affect the rate of chemical reactions.	...how different energy stores such as potential and chemical energies can be transferred into other stores such as kinetic energy (this will include calculating the transfer of energy from one form to another) ...ways to improve the efficiency of energy transfers, including the transfer of thermal energy and the use of insulation ...how electricity is made, transported around the UK and safely used in the home (the plug) ...why substances change state using the particle model of matter, this includes density, specific heat capacity and specific latent heat	
10	Entry Level Certificate ...what the body is made of in terms of cells, tissues, organs and systems; circulatory, digestive, nervous, endocrine and reproductive ...respiration (aerobic and anaerobic) ...healthy diet and lifestyle ...how the body response to infectious diseases; bacteria, viruses and the role of vaccination and antibiotics including how drugs are developed ...how the body is coordinated using hormones and electrical impulses ...feeding relationship between living organisms including the role of produces and photosynthesis, food chains and webs ...how plants and animals are adapted to survive in different environmental conditions ...how competition for resources can affect the survival of species and individual populations ...the theory of evolution and natural selection ...the types of reproduction (sexual and asexual) ...the role of DNA, genes and chromosomes in terms of determining sex and control of characteristics Trilogy and GCSE Biology ...the different methods of transporting substances across membranes ...the structure and function of different biological systems; respiratory, digestive, endocrine, nervous ...how different substances such as carbon, water and mineral ions are recycled in the environment. ...how adaptations lead to survival in the environment through competition ...why biodiversity is important and how it is maintained GCSE Biology Only in addition to the above but not the last point ...the use of monoclonal antibodies ...how pathogens may affect plants and their different defence mechanisms ...how the eye produces an image and ways to treat problems with vision ...structure and function of the brain ...how the kidney filters the blood and how renal failure is treated ...how the plant responds to stimuli	Entry Level Certificate ...the difference between atoms, elements and compounds ...the three states of matter and their properties including examples of carbon (diamond and graphite) ...how different techniques can be used to separate mixtures (filtration, distillation, crystallisation and chromatography) ...properties of metals including reactivity, structure ...extraction of metals from ores and the environmental implications ...what polymers are and their applications Trilogy and GCSE Chemistry ...how temperature, surface area, concentration and catalysts can affect the rate of a chemical reaction ...covalent, ionic, and metallic bonding with examples for each ...the allotropes of carbon ...how electrolysis can be used to separate some substances. ...the difference between acids and alkalis, pH scale and neutralisation (including examples and applications) ...different types of chemical reaction including neutralisation, exothermic, endothermic, making salts, oxidation and reduction GCSE Chemistry Only ...how titrations can be used to determine neutralisation ...how to calculate the energy changes involved in reactions ...mole and limiting factors ...how mass is conserve in chemical reaction ...how flame tests can be used to identify elements and ways to identify different types of ions	Entry Level Certificate ...energy stores and transfers ...efficiency and ways to improve it ...thermal conductivity (conduction) ...renewable and non-renewable energy resources ...the difference between contact and non-contact forces ...the factors that affect the work done (energy transferred) by an object ...the factors that affect thinking, braking and overall stopping distance of a vehicle ...radioactive decay in terms of stability of the nucleus and the radiation emitted (alpha, beta and gamma) Trilogy and GCSE Physics ...the different models of the atom and how experimentation has led to the nuclear model ...radioactive decay, half -life and applications of radioactivity ...the difference between charge, current and potential difference ...the relationship between current, potential difference and resistance in series and parallel circuits ...the characteristics and applications of diodes, thermistors and LDR ...the different types of waves and their characteristics and properties ...the use of the waves in the electromagnetic spectrum Trilogy Physics Only ...magnetic materials and their interactions (attract, repel, fields) ...applications of magnetism which include electromagnets, motors, and speakers GCSE Physics Only ...the structure of the solar system, galaxy, and universe ...use of satellites to make observations ...application of waves to look at evidence for the big bang (red shift) ...the stages and forces in the life cycle of different sized stars	By the end of Key Stage 3, with a greater degree of independence , pupils will be able to... ...identify variables in an investigation and explain how to make an investigation fair (awareness of bias) ...asking questions and make predictions (hypotheses) based on existing scientific knowledge ...describing a method that will enable valid results to be collected ...applying knowledge of a risk assessment to carry out a practical experiment safely ...applying knowledge of scientific equipment to identify which equipment is right for the job ...applying knowledge of equipment and units to make appropriate measurements ...understanding and using standard SI units and IUPAC chemical nomenclature ...using basic data analysis including simple statistical techniques (mean, range etc...) ...presenting experimental results as an appropriate chart or graph (bar charts, xy-scatter graphs) ...describing patterns in experimental results and draw conclusions based on experimental evidence. ...describing limitations of experimental evidence (reliability, repeatability, accuracy, precision). ...presenting evidence from a variety of sources. In Year 10 and 11 pupils will use the Working Scientifically methodology learnt throughout Key Stage 3 and apply them to the required practicals that are part of the AQA GCSE Science courses (Separate Sciences and Combined Science). Pupils will be expected to identify variables, independently follow written procedures and, with support, write their own methods to test hypotheses and predictions. Pupils will be able to explain which apparatus is the most appropriate for a given context. Pupils will independently present their observations in the most appropriate fashion, constructing their own tables and charts (xy-scatter graphs with lines of best fit or bar charts) and then independently write conclusions based upon the results and observations, writing evaluations and stating potential sources of error and ways to improvements to their methodology. In Years 10 and 11 the following skills will be covered... ...How experimentation can lead to new models ...Selecting variables to investigate, collection of data through taking measurements and observations ...Hypothesising and making predictions ...Observing and collecting data or using secondary sources ...Mean calculations, percentage change calculations and the reason we use it ...Graph drawing independently for example reaction time before and after caffeine ...Evaluation of results collected (identify anomalies), methods, and conclusions, including potential sources of error ...Modelling of DNA, Ethics aspects of science (human genome project, selective breeding, genetic engineering, embryo screening), evaluation of transplantation issues ...Practical experimentation can lead to new models – peer assessment and professional scientific method By the end of Year 11 we expect pupils to be able to... ...independently plan and carry out an experiment to obtain valid data from observations or by taking measurement and present their findings in tables and as appropriate graphs or charts ...interpret their finding alongside secondary sources to draw accurate scientific conclusions ...evaluate the experimental procedure used and result obtained and suggest future improvement In Years 12 and 13 pupils will be assessed using the CPAC criteria as directed by the AQA... ...Follows written methods to carry out a procedure or use a technique ...Uses the most suitable equipment correctly to ensure accuracy ...Identifies and controls significant quantitative variables ...Safely uses a range of practical equipment and materials ...Makes and records observations in a suitable format (table, biological drawing etc) ...Research materials and information to support observation and references sources used ...Writes standard scientific reports (aim, prediction, method, results, graphs, analysis, conclusion, evaluation)
11	Trilogy and GCSE Biology ...variation and natural selection ...evolutionary relationships, fossil evidence and classification ...genetic inheritance ...how characteristics are inherited in both sexual and asexual reproduction, the concept of dominant and recessive traits which can lead to selective breeding, and genetic engineering. ...evidence of evolution using antibiotic resistance GCSE Biology Only ...how new species can form over time ...how we clone organisms in a variety of ways	Trilogy and GCSE Chemistry ...how resources can be identified as finite or renewable. ... how ground water and salty water can be treated to make it potable. ...the composition of crude oil (hydrocarbon chains), ways to separate and 'crack' them ...how the process of fractional distillation works and the uses of the different fractions. ... the structure, properties of hydrocarbons and their uses ...the composition of the atmosphere ...products of combustion and their impact upon global warming / climate change ...how common gases and metals can be identified ...how chromatography can be used to separate some substances GCSE Chemistry Only how alkenes react with hydrogen, water and halogens. ...how alcohols react with sodium, air, water, and an oxidising agent ... how the first 4 carboxylic acids react with carbonates, dissolve in water, react with alcohols How polymers are formed by addition and condensation reactions ...how DNA and amino acids and other naturally occurring polymers are made. ...how ions are identified by chemical and spectroscopic means.	Trilogy Physics and GCSE Physics ...the difference between scalar, vector, contact and non-contact forces (giving examples) ...the motion of an object in terms of its speed, velocity, distance, displacement (including motion graphs), acceleration, momentum (higher only) and in terms of newtons laws of motion ...the factors which affect the overall stopping distance of a vehicle ...the effect of applying a force to an elastic object (spring) GCSE Physics ONLY ...atmospheric and fluid pressure ...moments and transfer of forces using gears ...magnetic materials and their interactions (attract, repel, fields) ...applications of magnetism which include electromagnets, motors, speakers and transformers	
12	A-Level Biology Year 1 ...how biological molecules are formed and their roles in living organisms ...the structure and function of the different types of cells, how they divide, how they interact in the immune system and how substances are moved in and out of them ...how substances are exchanged between organisms and their environments ...how genetic variation arises and how it is investigated	A level Chemistry Year 1 ...the different models of the atom, the arrangement of elements in the periodic table and electron configuration ...how simple time of flight (TOF) mass spectrometer can be used to identify elements and to determine relative molecular mass of substances ... how to measure the amount of a substance ... covalent, ionic, metallic bonding and dative bonding with examples for each ... shapes of molecules ...how energy changes occur during chemical reactions ... how temperature, surface area, concentration and catalysts can affect the rate of a chemical reaction. ... differences between properties of group 2 and group 7 elements ...how alkanes, alkenes, halogenoalkanes and alcohols react. ...how to identify different organic compounds using test tube reactions	A Level Physics Year 1 ...explain what common particles are made from e.g. quark and lepton structure. ...what has to be conserved for a particle interaction to occur ...the wave and particle behaviour of light ...explain how potential difference and current behave in a range of circuits including what factors affect them ...calculate a range of quantities of circuits including charge and resistance of varying circuits. ...use a range of practical techniques to investigate circuits including resistivity ...explain why objects topple in terms of their centre of mass and moments around a pivot, and the distribution of forces upon supports ...explain the linear motion of an object in terms of their horizontal and vertical components ... describe the motion of an object using newtons laws of motion to describe changes in momentum, work, and power ...properties of materials including density, elasticity (Hooke's law) and Youngs Modulus ...different types of wave and their properties including superposition, refraction, critical angle, diffraction	
13	A-Level Biology Year 2 ...how energy is transferred in and between organisms ...how organisms respond to their environments on a cellular level and as organisms ...how genetic inheritance leads to evolution and speciation in populations and in ecosystems ...how our knowledge of DNA and genes can be used in gene technology in regulation and control of gene expression	Al Level Chemistry Year 2the physical and chemical differences between aldehydes and ketones. ...the properties and uses of carboxylic and their derivatives ... the structure, reactivity and properties of aromatic compounds ...the relationship between, amino acids, proteins and DNA ...how to NMR spectroscopy is used as an analytical tool ...how electricity can be used to split chemicals to make useful products ...how heat is transferred during chemical reactions ...properties of period 3 elements and their oxides ...how new materials can be formed by a causing a chemical change in the starting materials	A Level Physics Year 2 ...evaluate the Rutherford scattering model ...explain the properties of alpha, beta and gamma radiation ...calculate the decay constant, the number of nuclei and the activity of a sample ...describe how stability changes and nuclear radius change with atomic mass ...be able to convert between mass, energy and atomic mass units ...describe how a cathode ray tube works ...explain the evidence for the theory of wave particle duality ...how photoelectricity was discovered ...describe special relativity ...calculate time and length dilation and mass being converted to energy ...explain circular motion, simple harmonic motion, and ways of reducing vibrations (damping) ...describe the changes in thermal energy of a system, use specific latent heat and specific heat capacity to explain and calculate changes to substances, use the ideal gas equation to explain the effect of changes upon a gas. Turning Points in Physics ...importance of the discovery of the electron, specific change of an electron including Millikan's experiment and application such as electron microscopes	