Lever Park, Bolton Impact Trust Science Curriculum

Rationale

As a Trust, we believe that a high quality Science education provides a foundation for understanding the world through the specific disciplines of biology, chemistry and physics. Pupils will gain an understanding and appreciation of the ways in which science has shaped our world and the importance that science has on the world's future prosperity. Pupils will learn to think as a scientist and will develop a curiosity and interest in how science can be used to understand, analyse and predict the world we live in.

Knowledge

We ensure that throughout the Science curriculum pupils acquire the key knowledge required to:

- Understand the specific disciplines of biology, chemistry and physics
- Develop an 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
- Understand the uses and implications of science, today and for the future

Character

We ensure that pupils develop their own character attributes by understanding the impact that they have upon the world around them, and the responsibilities that they have as an individual but also as part of the wider society to protect their world. We encourage pupils to take part in ethical discussions and to be open and empathic to alternative viewpoints.

Creativity

We ensure that pupils value and develop their own creativity by sharing with them the inventions, innovations and discoveries which science has made through individuals being creative in their thinking; and by doing so, have had a profound impact upon the world and our understanding of it.

Innovative Thinking

We inspire pupils to think scientifically. To understand the importance of objectivity, accuracy, precision, repeatability and reproducibility. To evaluate risks and to understand that methods and theories develop over time as new evidence and ideas are taken into account. We encourage pupils to be curious about the world and to ask questions, to develop a passion for investigation and research and to analyse and make predictions about the world we live in.

Transform

Pupils will transform the essential knowledge and skills that they are taught in the Science curriculum into long-lasting success in the world of further study and work. They will be equipped with a wide range of transferable skills such as problem solving, practical and numerical skills, enquiry and reasoned debate, analytical skills, scientific literacy and teamwork. Pupils will be exposed to, and will appreciate the myriad of opportunities for scientists in the modern world; particularly in the fields of health, medicine, transport, defence and security.

Science Curriculum Design

Science encourages types of learning such as critical thinking and problem solving which will be applicable in the rest of pupils lives in and outside of the classroom. It enables pupils to think logically and scientifically and be able to solve problems. At Lever Park Academy our intent is to ensure all pupils leave with a basic understanding of the 3 key Science subjects.

The Science curriculum has been carefully planned and sequenced so that knowledge builds upon prior knowledge and as pupils move through the academic year and the various knowledge and understanding is deepened and regularly revisited. Our curriculum topics are planned in a way which ensures that our pupils can learn the most important key component knowledge at both key stages which build in depth and level of challenge for each term that they are with us. Knowledge and skills are repeated regularly to enable pupils to retrieve prior learning regularly, to increase their confidence, and to address the needs of the pupils who join us throughout the year and with vastly different abilities and experiences of the Science curriculum prior to joining us. Pupils who leave us to return to mainstream are able to re-engage with the Science curriculum there.

Pupils gain a variety of cultural capital opportinues in Science, including visiting Manchester Science and Industry Museum. We provide engaging Science lessons weekly whilst teaching the National Curriculum topics to develop their working scientifically skills. We encourage our pupils to extend their vocabulary within Science and refer to key words in and outside of the classroom. We take advantage of any opportunity to visit local or the wider community to see what is happening around us within Science.

The Key Stage 3 Science Curriculum Intent

In key stage 3 we have used the syllabus from AQA to inform our planning. This syllabus provides an alternative approach to KS3 content. Content is under 10 big idea headings: Forces, Electromagnetism, Energy, Waves, Matter, Reactions, Earth, Organisms, Ecosystems and Genes. Each idea contains four smaller topics: the building blocks for the big ideas. This sequence of knowledge leads to pupils developing their understanding of a big idea by beginning with simpler, more concrete topics and moving to more abstract ones as they work through the curriculum. This way of sequencing knowledge helps pupils to secure key knowledge that they can then apply to less familiar topics. We have chosen to deliver the units by starting with chemistry because this provides pupils with prerequisite knowledge of atoms as the building blocks of all living things, and how atoms react during chemical reactions that are essential for life. When planning the curriculum we have been explicit in outlining not only what pupils will **know**, but also how they will **apply** this knowledge. The AQA syllabus ensures that pupils are encouraged to think like a scientist by including opportunities for pupils to analyse, communicate, enquire and solve in every topic. We also ensure that pupils can access the science curriculum by ensuring that key subject specific vocabulary is identified and explicitly taught in every unit.

Through the delivery of the Key stage 3 curriculum we support pupils to understand how Science relates to the wider world outside of the classroom by linking in real-life scenarios and other cross curriculuar links. For example if pupils are learning in Year 8 Summer term about the Human body and the digestion this

links to ‘Healthy Me’ theme in PHSE and how this can be realted to real-life. Pupils are offered 1 x 50 minute lesson per week of Science, this allows pupils to gain experience of the Science curriculum and develop the fundermental skills to live in society within a scientific culture.

Key Stage 3	Autumn Matter, Reactions and Earth →	Spring Forces, Electromagnetics, Energy and Waves →	Summer Organisms, Ecosystem and Genes →
Year 7	• Particle model • Separating Mixtures • Metals and Non-metals • Acids and Alkalis	• Speed • Gravity • Voltage and resistance • Energy cost • Energy Transfer • Sound • Light	• Movement • Cells • Interdependence • Plant reproduction
Year 8	• Periodic table • Elements • Earth Structure • Universe	• Contact Forces • Pressure • Electromagnets • Magnetism	• Breathing • Digestion • Variation • Human reproduction
Year 9	• Chemical energy • Types of reaction • Climate • Earth resources	• Work • Heating and Cooling • Wave Effects • Wave Properties	• Respiration • Photosynthesis • Evolution • Inheritance

In order to help teachers to deliver the key stage 3 science curriculum at an appropriate level to pupils, we have produced a ladder of the key substantive knowledge and disciplinary knowledge for each topic of the curriculum that builds in complexity. This helps teachers to build knowledge upon knowledge as the units are delivered and allows the curriculum to be adapted to meet the needs of the pupils as they learn.

Matter		Entering →	Emerging →	Developing →	Securing
Particle Model	Substantive Knowledge		*As previous levels, plus:* The particle model of solids, liquids and gases	*As previous levels, plus:* Changes of state in terms of the particle model	*As previous levels, plus:* Properties of states of matter including

		That everything is made of tiny particles called atoms The three states of matter & examples	The properties of the different states of matter in terms of the particle model - differences in arrangements, motion closeness of particles explaining changes of state, shape and density	Diffusion in terms of the particle model Changes with temperature in motion and spacing of particles	expansion, contraction and gas pressure The anomaly of ice-water transition (increase in volume when water freezes) Internal energy stored in materials
	Disciplinary Knowledge	Interpret observations to draw conclusions Understand and use SI units	Understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas	Make predictions using scientific knowledge and understanding Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions	Identify further questions arising from results
Separating Mixtures	Substantive Knowledge	Mixtures, including dissolving & basic vocabulary (dissolve & solution) Simple separating techniques - filtration only	*As previous levels, plus:* Dissolving & key vocabulary (solute & solvent) The concept of a pure substance Separating techniques - filtration & evaporation	*As previous levels, plus:* Diffusion in terms of the particle model Separating techniques - distillation and chromatography	*As previous levels, plus:* Identification of pure substances in terms of melting & boiling points
	Disciplinary Knowledge	Interpret observations to draw conclusions use appropriate techniques, apparatus,	Understand that scientific methods develop to take account of new ideas	Make predictions using scientific knowledge	Identify further questions arising from results

		and materials, paying attention to health and safety		Interpret observations and data, including identifying patterns	
Periodic Table	Substantive Knowledge	The Periodic Table is organised into groups; metals and non-metals Basic physical and chemical properties of some elements	*As previous levels, plus:* The Periodic Table is organised into Periods and groups; metals and non-metals	*As previous levels, plus:* How patterns in reactions can be predicted with reference to the Periodic Table	*As previous levels, plus:* The principles underpinning the Mendeleev Periodic Table – how Mendeleev left gaps and could make predictions on the properties unknown elements
	Disciplinary Knowledge	Understand that scientific theories develop as earlier explanations are modified to take account of new evidence		Make predictions using scientific knowledge	
Elements	Substantive Knowledge	Identifying atoms, elements, molecules and compounds from simple particle diagrams Building simple models	*As previous levels, plus:* Describe differences between atoms, elements and compounds – scientific definitions	*As previous levels, plus:* Describe a simple (Dalton) atomic model	*As previous levels, plus:* Write chemical symbols and formulae for elements and compounds
	Disciplinary Knowledge	Understand that scientific 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	Use and derive simple equations Make predictions using scientific knowledge and understanding

Reactions		Entering →	Emerging →	Developing →	Securing
Metals and non-metals	Substantive Knowledge	Physical properties of metals and non-metals	*As previous levels, plus:* Chemicial properties of metals and non-metals	*As previous levels, plus:* Chemical properties of metal and non-metal oxides	*As previous levels, plus:* Chemical properties of metal and non-metal oxides with respect to acidity
	Disciplinary Knowledge	Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge. Make predictions using scientific knowledge and understanding			
Acids and Alkalis	Substantive Knowledge	Identifying common examples of acids and alkalis The pH scale for measuring acidity/alkalinity; and indicators Identify hazard symbols and some safety precautions when working with acids & alkalis	*As previous levels, plus:* Reactions of acids with metals to produce a salt plus hydrogen How to test a gas for Hydrogen Simple word equations for acid + metal reactions	*As previous levels, plus:* Neutralisation reactions as eactions of acids with alkalis to produce a salt plus water Simple word equations for Neutralisation reactions Simple chemical equations for acid + metal reactions	*As previous levels, plus:* Simple chemical equations for Neutralisation reactions
	Disciplinary Knowledge	Use appropriate techniques, apparatus, and materials during laboratory work, paying attention to health and safety	Make and record observations and evaluate the reliability of methods	Use and derive simple equations Make predictions using scientific knowledge and understanding	Ask questions based on observations of the real world, alongside prior knowledge

Chemical Energy	Substantive Knowledge			Energy changes on changes of state (qualitative)	*As previous levels, plus:* Exothermic and endothermic chemical reactions (qualitative)
	Disciplinary Knowledge			Ask questions based on observations of the real world, alongside prior knowledge	
Types of reaction	Substantive Knowledge	Difference between chemical reactions and physical changes Identifying reactants and products in a simple reaction	*As previous levels, plus:* Chemical reactions as the rearrangement of atoms (reactants) to form products Representing chemical reactions using simple word equations Combustion reactions	*As previous levels, plus:* Representing chemical reactions using formulae in equations Conservation of mass in chemical reactions Thermal decomposition and oxidation reactions The order of metals and carbon in the reactivity series	*As previous levels, plus:* Balancing simple chemical equations Displacement reactions Role of catalysts in chemical reactions and importance in industry The use of carbon in obtaining metals from metal oxides Properties of ceramics, polymers and composites
	Disciplinary Knowledge	Use appropriate techniques, apparatus, and materials during 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	Use and derive simple equations Make predictions using scientific knowledge and understanding	Ask questions based on observations of the real world, alongside prior knowledge

Earth		Entering →	Emerging →	Developing →	Securing
Earth Structure	Substantive Knowledge	The 4 part structure of the Earth	*As previous levels, plus:* The composition of the Earth in terms of elements e.g. Iron & Nickel	*As previous levels, plus:* The rock cycle and the formation of igneous, sedimentary and metamorphic rocks	*As previous levels, plus:* Basic idea of plate tectonics *(Geography curriculum link)*
	Disciplinary Knowledge	Understand that scientific theories develop as earlier explanations are modified to take account of new evidence			The importance of publishing results and peer review
Universe	Substantive Knowledge	The scale of the Universe The structure of the solar system Earth's rotation and days length. Earth's orbit around the Sun and year length – leap years Our Sun as a star, other stars in our galaxy, other galaxies	*As previous levels, plus:* The seasons and the Earth's tilt, day length at different times of year, in different hemispheres Gravity different on other planets and stars; gravity forces between Earth and Moon, and between Earth and Sun (qualitative only)	*As previous levels, plus:* Gravity force (weight) = mass x gravitational field strength (g), on Earth g=10 N/kg,	*As previous levels, plus:* The light year as a unit of astronomical distance - mathematical conversion to km
	Disciplinary Knowledge	Understand that scientific theories develop as earlier explanations are modified to take account of new evidence and ideas		Apply mathematical concepts and calculate results. Understand and use SI units	Interpret observations and data, including identifying patterns and using observations, to draw conclusions.

				Present observations and data using tables and graphs	Present explanations in relation to predictions and hypotheses
Climate	Substantive Knowledge		*As previous levels, plus:* Composition of the atmosphere	*As previous levels, plus:* The evolution of Earth's atmosphere The production of carbon dioxide by human activity and the predicted impact on climate	*As previous levels, plus:* The carbon cycle Consequences of climate change The integrity of scientific data on climate change and human impact
	Disciplinary Knowledge		Understand that scientific theories develop as earlier explanations are modified to take account of new evidence and ideas The importance of publishing results and peer review		
Earth's Resources	Substantive Knowledge	Earth as a source of useful resources	*As previous levels, plus:* Earth's resources are limited Sustainability and the importance of recycling. Problems with using plastics	*As previous levels, plus:* Consequences of dependence on fossils fuels and overuse of plastics	*As previous levels, plus:* The efficacy of recycling – is it working?
	Disciplinary Knowledge	Understand and use SI units Present observations and data using tables and graphs	Apply mathematical concepts and calculate results	Make predictions using scientific knowledge	Ask questions based on observations and prior knowledge

Forces		Entering →	Emerging →	Developing →	Securing
Speed	Substantive Knowledge	Relative speed of fast & slow objects – exploring the meaning of speed	*As previous levels, plus:* The quantitative relationship between average speed, distance and time (speed = distance ÷ time) & correct units	*As previous levels, plus:* The representation of a journey on a distance-time graph Forces being needed to cause objects to stop or start moving, or to change their speed or direction of motion (qualitative only) Change in motion depending on direction of force and its size	*As previous levels, plus:* Acceleration as the change in speed over time & correct units
	Disciplinary Knowledge	Understand and use SI units Present observations and data using tables and graphs	Apply mathematical concepts and calculate results	Make predictions using scientific knowledge	Ask questions based on observations and prior knowledge
Gravity	Substantive Knowledge	How gravity was discovered	*As previous levels, plus:* Gravity different on other planets and stars; gravity forces between Earth and Moon, and between Earth and Sun (qualitative only)	*As previous levels, plus:* Gravity force (weight) = mass x gravitational field strength (g), on Earth g=10 N/kg	*As previous levels, plus:* The nature of gravity as a very weak force, yet one which we experience daily How gravitational force changes with distance (inverse-square law)

	Disciplinary Knowledge	Understand that scientific theories develop as earlier explanations are modified to take account of new evidence and ideas	The importance of publishing results and peer review	Understand and use SI units. Present observations and data using tables and graphs. Apply mathematical concepts and calculate results. Make predictions using scientific knowledge	Ask questions based on observations and prior knowledge
Contact Forces	Substantive Knowledge	Forces as pushes or pulls, arising from the interaction between two objects Using force arrows in diagrams, adding forces in one dimension deforming objects; stretching and squashing a spring Friction between surfaces Forces measured in newtons	*As previous levels, plus:* Resistance to motion of air and water Balanced and unbalanced forces Non-contact forces: gravity forces acting at a distance on Earth and in space, forces between magnets and forces due to static electricity	*As previous levels, plus:* Measurements of stretch or compression as force is changed Opposing forces and equilibrium: weight held by stretched spring or supported on a compressed surface	*As previous levels, plus:* Moment as the turning effect of a force Force-extension linear relation; Hooke's Law as a special case Work done and energy changes on deformation
	Disciplinary Knowledge	Use SI units. Present data using tables and graphs.	Make and record observations Make predictions using scientific knowledge	Select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables	

				Use appropriate techniques, apparatus, and materials during laboratory work, paying attention to health and safety Make and record measurements. Evaluate the reliability of methods and suggest improvements Apply mathematical concepts and calculate results.	
Pressure	Substantive Knowledge	Floating and sinking	*As previous levels, plus:* Pressure in liquids, increases with depth; upthrust effects	*As previous levels, plus:* Atmospheric pressure, decreases with increase of height	*As previous levels, plus:* Pressure as force over area – acting normal to any surface
	Disciplinary Knowledge	Use SI units. Present data using tables and graphs	Make and record observations. Make predictions using scientific knowledge. Apply mathematical concepts and calculate results.		

Electromagnets		**Entering** →	**Emerging** →	**Developing** →	**Securing**
Voltage and resistance	Substantive Knowledge		Potential difference, measured in volts	*As previous levels, plus:* Separation of positive or negative charges when objects are rubbed together: transfer of electrons, forces between charged objects The idea of electric field, forces acting across the space between objects not in contact	*As previous levels, plus:* Battery and bulb ratings; resistance, measured in ohms, as the ratio of potential difference (p.d.) to current Differences in resistance between conducting and insulating components (quantitative)

	Disciplinary Knowledge		Use SI units. Make and record observations	Ask questions based on observations and prior knowledge	Make predictions using scientific knowledge
Current	Substantive Knowledge		Electric current, measured in amperes, in circuits	*As previous levels, plus:* Series and parallel circuits, currents add where branches meet and current as flow of charge	*As previous levels, plus:*
	Disciplinary Knowledge		Use SI units. Make and record observations	Ask questions based on observations and prior knowledge	Make predictions using scientific knowledge
Magnetism & electromagnets	Substantive Knowledge	Magnetic poles, attraction and repulsion	*As previous levels, plus:* Magnetic fields - plotting with compass, representation by field lines	*As previous levels, plus:* Earth's magnetism, compass and navigation The magnetic effect of a current	*As previous levels, plus:* Electromagnets, D.C. motors (principles only). Other effects of magnetic fields – Aurora borealis
	Disciplinary Knowledge	Understand that scientific theories develop as earlier explanations are modified to take account of new evidence and ideas		Ask questions based on observations and prior knowledge	Make predictions using scientific knowledge
Energy		**Entering** →	**Emerging** →	**Developing** →	**Securing**
Energy Costs	Substantive Knowledge		*As previous levels, plus:*	*As previous levels, plus:*	*As previous levels, plus:*

			Fuels and energy resources	Domestic fuel bills, fuel use and costs	Comparing amounts of energy transferred (J, kJ, kW hour)
	Disciplinary Knowledge		Ask questions based on observations and prior knowledge		Use SI units. Apply mathematical concepts and calculate results
Energy Transfer	Substantive Knowledge	Comparing energy values of different foods (from labels) (kJ)	*As previous levels, plus:* Comparing power ratings of appliances in watts (W, kW) Energy as a quantity that can be quantified and calculated; the total energy has the same value before and after a change	*As previous levels, plus:* Other processes that involve energy transfer: changing motion, dropping an object, completing an electrical circuit, stretching a spring, metabolism of food, burning fuels	*As previous levels, plus:* Simple machines give bigger force at the expense of smaller movement (vice versa): product of force and displacement unchanged
	Disciplinary Knowledge	Use SI units. Present data using tables and graphs	Apply mathematical concepts and calculate results	Ask questions based on observations of the real world, using prior knowledge	Make predictions using scientific knowledge
Work	Substantive Knowledge				Work done as energy transferred (J)
	Disciplinary Knowledge				Use SI units. Apply mathematical concepts and calculate results
Heating and Cooling	Substantive Knowledge			*As previous levels, plus:*	*As previous levels, plus:*

			Temperature difference between two objects leading to energy transfer from the hotter to the cooler one	Heating and thermal equilibrium: through contact (conduction) or radiation; such transfers tending to reduce the temperature difference: use of insulators	Comparing the starting with the final conditions of a system and describing increases and decreases in the amounts of energy associated with movements, temperatures, changes in positions in a field, in elastic distortions and in chemical compositions
	Disciplinary Knowledge		Apply mathematical concepts and calculate results	Ask questions based on observations of the world, using prior knowledge	Make predictions using scientific knowledge

Waves		**Entering** →	**Emerging** →	**Developing** →	**Securing**
Sound	Substantive Knowledge	Sound produced by vibrations of objects	*As previous levels, plus:* Sound needs a medium to travel, the speed of sound in air, in water, in solids	*As previous levels, plus:* Frequencies of sound waves, measured in hertz (Hz); echoes, reflection and absorption of sound	*As previous levels, plus:* Auditory range of humans and animals
	Disciplinary Knowledge	Ask questions based on observations and prior knowledge	Apply mathematical concepts. Use SI units.	Present data using tables and graphs	
Light	Substantive Knowledge		*As previous levels, plus:* Use of ray model to explain imaging in mirrors, the pinhole	*As previous levels, plus:*	*As previous levels, plus:* Transmission of light through materials: absorption, diffuse

		Light travels in straight lines – simple ray model to explain shadows	camera, the refraction of light and action of convex lens in focusing (qualitative); the human eye Similarities and differences between light waves and waves in matter	Light waves travel through a vacuum; speed of light Light transferring energy from source to absorber leading to chemical and electrical effects; photo-sensitive material in the retina and in cameras	scattering and specular reflection at a surface Colours and the different frequencies of light, white light and prisms (qualitative only); differential colour effects in absorption and diffuse reflection
	Disciplinary Knowledge	Ask questions based on observations and prior knowledge	Understand that scientific theories develop as earlier explanations are modified to take account of new evidence		Make predictions using scientific knowledge
Wave Effects	Substantive Knowledge			Waves can be reflected, and add or cancel – superposition	*As previous levels, plus:* Pressure waves transferring energy; use for cleaning and physiotherapy by ultra-sound; waves transferring information for conversion to electrical signals by microphone

	Disciplinary Knowledge			Ask questions based on observations and prior knowledge	Make predictions using scientific knowledge
Wave properties	Substantive Knowledge		Waves on water as energy transfer through undulations	*As previous levels, plus:* Difference between transverse & longitudinal waves	*As previous levels, plus:* Waves travel through water with transverse motion
	Disciplinary Knowledge		Understand that scientific theories develop as earlier explanations are modified to take account of new evidence. Ask questions based on observations and prior knowledge		

Organisms		**Entering** →	**Emerging** →	**Developing** →	**Securing**
Movement	Substantive Knowledge	Structure and functions of the human skeleton, to include support, protection, movement…	*As previous levels, plus:* …and making blood cells	*As previous levels, plus:* The function of muscles and examples of antagonistic muscles	*As previous levels, plus:* Biomechanics – the interaction between skeleton and muscles, including the measurement of force exerted by different muscles
	Disciplinary Knowledge	Ask questions based on observations and prior knowledge			Apply mathematical concepts. Use SI units.
Cells	Substantive Knowledge	Cells as the fundamental unit of living organisms	*As previous levels, plus:*	*As previous levels, plus:* The role of diffusion in the movement of	*As previous levels, plus:* The hierarchical organisation of

			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 Similarities and differences between plant and animal cells	materials in and between cells	multicellular organisms: from cells to tissues to organs to systems to organisms. The structural adaptations of some unicellular organisms
	Disciplinary Knowledge	Ask questions based on observations and prior knowledge			Present data using tables
Breathing	Substantive Knowledge	Why we breathe in terms of supplying oxygen to stay alive, and the role of the lungs in simple terms	*As previous levels, plus:* The structure and functions of the gas exchange system in humans, including adaptations to function	*As previous levels, plus:* 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 The impact of exercise, asthma and smoking on the human gas exchange system	*As previous levels, plus:* The role of leaf stomata in gas exchange in plants
	Disciplinary Knowledge	Ask questions based on observations and prior knowledge		Present data using tables and graphs	Ask questions based on prior knowledge

Digestion	Substantive Knowledge	Content of a healthy human diet: carbohydrates, lipids (fats and oils), proteins, vitamins, minerals, dietary fibre and water…	*As previous levels, plus:* … and why each nutrient is needed Calculations of energy requirements in a healthy daily diet Consequences of imbalances in the diet, including obesity, starvation and deficiency diseases	*As previous levels, plus:* the tissues and organs of the human digestive system, including adaptations to function… The effects of recreational drugs (including substance misuse) on behaviour, health and life processes	*As previous levels, plus:* … and how the digestive system digests food (enzymes simply as biological catalysts) The importance of bacteria in the human digestive system
	Disciplinary Knowledge	Present data using tables and graphs. Ask questions based on observations and prior knowledge			

Ecosystem		**Entering** →	**Emerging** →	**Developing** →	**Securing**
Interdependence	Substantive Knowledge		The interdependence of organisms in an ecosystem, including food webs and insect pollinated crops	*As previous levels, plus:* The importance of plant reproduction through insect pollination in human food security	*As previous levels, plus:* How organisms affect, and are affected by, their environment, including the accumulation of toxic materials
	Disciplinary Knowledge		Present data using tables and graphs. Ask questions based on observations and prior knowledge. Interpret data, including patterns, to draw conclusions		
Plant reproduction	Substantive Knowledge	Reproduction in plants, including flower structure	*As previous levels, plus:*	*As previous levels, plus:* Seed dispersal methods	*As previous levels, plus:*

			Wind and insect pollination, fertilisation, seed and fruit formation		Quantitative investigation of seed dispersal methods
	Disciplinary Knowledge	Ask questions based on observations and prior knowledge			Apply mathematical concepts and calculate results. Present data using tables and graphs. Interpret data to draw conclusions
Respiration	Substantive Knowledge	All living organisms on Earth need energy to survive, and this energy is released inside cells	*As previous levels, plus:* Respiration occurs in living organisms, including the breakdown of glucose to release energy for other chemical processes necessary for life	*As previous levels, plus:* A word summary for aerobic respiration How anaerobic respiration is different, and why it is sometimes necessary	*As previous levels, plus:* The process of anaerobic respiration in humans and micro-organisms, including fermentation, and a word summary for anaerobic respiration
	Disciplinary Knowledge	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			
Photosynthesis	Substantive Knowledge	Plants make their own food, using energy from the sun	*As previous levels, plus:* Plants make carbohydrates in their leaves by photosynthesis and gain mineral nutrients and water from the soil via their roots	*As previous levels, plus:* The reactants in, and products of, photosynthesis, and a word summary for photosynthesis The adaptations of leaves for photosynthesis	*As previous levels, plus:* The dependence of almost all life on Earth on the ability of photosynthetic organisms, such as plants and algae, to use sunlight in photosynthesis to build organic molecules that are an essential energy store and to maintain

					levels of oxygen and carbon dioxide in the atmosphere
	Disciplinary Knowledge	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			

Genes		Entering →	Emerging →	Developing →	Securing
Human reproduction	Substantive Knowledge	Reproduction in humans (as an example of a mammal), including the structure and function of the male and female reproductive system	*As previous levels, plus:* The role of gametes in fertilisation	*As previous levels, plus:* Gestation and birth, to include the effect of maternal lifestyle on the foetus through the placenta	*As previous levels, plus:* The menstrual cycle (without details of hormones)
	Disciplinary Knowledge	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			
Inheritance	Substantive Knowledge	That we inherit characteristics from parents through sperm and egg cells	*As previous levels, plus:* Heredity as the process by which genetic information is transmitted from one generation to the next via gametes	*As previous levels, plus:* A simple model of chromosomes, genes and DNA	*As previous levels, plus:* The part played by Watson, Crick, Wilkins and Franklin in the development of the DNA model Genetic disorders may be inherited – Cystic Fibrosis

	Disciplinary Knowledge	Ask questions based on observations	Understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review		
Variation and Evolution	Substantive Knowledge	That all organisms show variation - well-known examples That organisms complete for food, space, resources and mates	*As previous levels, plus:* The variation between individuals within a species being continuous or discontinuous, to include measurement and graphical representation of variation	*As previous levels, plus:* Differences between species, and the significance of producing viable offspring Changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction	*As previous levels, plus:* The variation between species and between individuals of the same species means some organisms compete more successfully, which can drive natural selection The importance of maintaining biodiversity and the use of gene banks to preserve hereditary material
	Disciplinary Knowledge	Ask questions based on observations	Understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review		

Assessment and Progress in Key Stage 3 Science

The Trust has established its own grade descriptors for Science in all of its secondary provisions, they range from GCSE level 1 to grade 9. The grade descriptors are aligned with GCSE grades, Functional Skills levels and Pearson Steps and they are called 'BIT Levels'. In Key Stage 3 Progress is reported in these levels each term and teachers are expected to make a 'best fit' decision on which level each pupil is at for using a mixture of formative and summative assessments throughout each term. These levels are moderated both by the Science subject leads, SLT and the Trust's Central Team.

BIT Level Descriptors for Science

BIT Level	Descriptor
9	To achieve grade 9, students' evidence will show that they have securely met all the statements within the grade 8 descriptor, with stronger performance in most or all aspects of the grade 8 statements.
8	To achieve grade 8, candidates will be able to: • demonstrate relevant and comprehensive knowledge and understanding and apply these correctly to both familiar and unfamiliar contexts using accurate scientific terminology • develop accurate, logical and detailed descriptions, explanations and arguments • use a range of mathematical skills to perform complex, multi-step scientific calculations • critically analyse qualitative and quantitative data and draw logical, well-evidenced conclusions • critically evaluate and refine methodologies, and judge the validity of scientific conclusions
7	To achieve grade 7, students' evidence will show that they have securely met all the statements within the grade 6 descriptor, with stronger performance in most or all aspects of the grade 6 statements. However, their evidence does not meet the minimum requirements of most of the grade 8 statements.
6	To achieve grade 6, candidates will be able to: • demonstrate accurate and relevant knowledge and understanding and apply these mostly correctly to both familiar and unfamiliar contexts using accurate scientific terminology • develop accurate, logical and detailed descriptions and straightforward explanations

	• use a range of mathematical skills to perform multi-step scientific calculations • analyse qualitative and quantitative data and draw logical conclusions, supported by evidence • evaluate methodologies to suggest improvements and developments to experimental methods, and comment on the accuracy and validity of scientific conclusions
5	To achieve grade 5, candidates will be able to: • demonstrate mostly accurate and appropriate knowledge and understanding and apply these mostly correctly to familiar and unfamiliar contexts, using mostly accurate scientific terminology • develop mostly accurate and logical descriptions, which includes some relevant detail and simple explanations • use appropriate mathematical skills to perform multi-step calculations • analyse qualitative and quantitative data and draw plausible conclusions supported by some evidence • evaluate methodologies to suggest improvements to experimental methods, and comment on the accuracy of scientific conclusions
4	To achieve grade 4, candidates will be able to: • demonstrate some accurate and appropriate knowledge and understanding and apply these to some familiar and unfamiliar contexts, using some accurate scientific terminology • develop some logical descriptions, which includes some accurate and relevant detail • use appropriate mathematical skills to perform calculations • interpret qualitative and quantitative data and draw conclusions supported by some evidence • suggest improvements to experimental methods, and comment on the accuracy of scientific conclusions
3	Characteristics that differentiate a grade 3 from a grade 4: • correct answers more likely to address familiar contexts than unfamiliar contexts • correct answers more likely where prompts and scaffolding are provided • descriptions are often partial and lacking relevant detail • perform some calculations when scaffolding is given • draw conclusions from qualitative or quantitative data, but evidence to support may not be clear or present • make some comments relating to experimental methods, but may not demonstrate an understanding of how to improve the experimental method or the accuracy of scientific conclusions

2	To achieve grade 2, candidates will be able to: demonstrate some relevant scientific knowledge and understanding using limited scientific terminology • perform some basic calculations • draw simple conclusions from qualitative or quantitative data • make basic comments relating to experimental methods
1	To achieve a grade 1, students' evidence will show that they have demonstrated engagement with sufficient content, achieved some credit across elements of the curriculum content and in some assessment objectives.

The Science Curriculum Intent – KS4

Key Stage 4

The key stage 4 curriculum continues to build upon the knowledge and skills that were delivered at key stage 3. Pupils are expected to continue to develop their knowledge of science and to continue to develop their skills in working scientifically. We offer a Level 1 BTEC qualification in Applied Science through our Vocational offer. This covers Biology, Chemistry and Physics and helps support pupils scientific knowledge and understanding. We offer Science at Award, Certificate and Diploma level and each pupil is offered this to suit their individual needs and ability. Pupils gain the hands on experience of creating chemical products, investigating crime scences and presenting evidence exploring all 3 areas of the science curriculum (Biology, Chemistry and Physics) which supports a well rounded thought out science curriculum. Pupils also have the opportunity to carry of scientific experiments and discover practical actions to protect the enrivoment.

For any pupils who show a particular talent and interest in Science, we are also able to offer the chance to study it at GCSE level with support from other academies within the Trust.

Key Stage 4 Applied Science	**Autumn** →	**Spring** →	**Summer** →
Year 10	**Exploring Biology** Learning Aims: - Investigate differences in living organisms - Present results of scientific experiments into differences in living organisms.	**Exploring Chemistry** Learning Aims: - Explore key concepts of chemistry - Prepare a product using different chemical processes.	**Exploring Physics** Learning Aims: - Explore different aspects of physics - Construct simple electric circuits safely and take electrical measurements.
Year 11	**Making a Chemical Product** Learning Aims: - Plan and make a chemical product - Review own performance and fitness for purpose of a chemical product.	**Investigating Crime Scence Evidence** Learning Aims: - Use procedures to collect and analyse crime scene evidence - Present conclusions drawn from simulated crime scene evidence.	

Assessment and Progress in Applied Science in Key Stage 4

Grade	Exploring Biology	Exploring Chemistry	Exploring Physics	Making a Chemical Product	Investigating Crieme Science Evidence
Pass	• Conduct scientific experiments to find out about the differences in living organisms. • Present findings of results showing the differences in living organisms.	• Search for information on an agreed concept of chemistry using given sources • Follow instructions to safely prepare a product using given scientific apparatus, demonstrating limited housekeeping skills	• Search for information on an agreed aspect of physics using given sources. • Construct a simple electrical circuit and measure its effectiveness, using equipment and tools safely.	• Produce an outline plan to make a chemical product • Use some practical skills and equipment to make a chemical product. • Review own performance in making a chemical product, identifying own strengths	• Use simple procedures to collect and analyse evidence from a simulated crime scene. • Produce outline conclusions drawn from crime scene evidence for a simulated crime scene. • Present conclusions, using simple diagrams and data with annotations.
Merit	• Conduct effective scientific experiments to find out about the differences in living organisms. • Present findings of the results, showing accurate information about the differences between living organisms.	• Search for information on an agreed chemical concept using own and given sources. • Follow instructions to prepare a product by setting up and using given apparatus correctly, demonstrating appropriate housekeeping skills.	• Search for information on an agreed aspect of physics using own and given sources. • Construct an adequate electrical circuit and measure its effectiveness, using equipment and tools safely.	• Produce a plan with some detail to make a chemical product • Use relevant practical skills and equipment to make a chemical product. • Review own performance in making a chemical product, describing its fitness for purpose and areas for improvement in own performance.	• Use appropriate procedures to collect and analyse evidence from a simulated crime scene. • Produce detailed conclusions drawn from crime scene evidence for a simulated crime scene. • Present conclusions, selecting appropriate information and

					using well-formatted diagrams and data.
Distinction	• Conduct comprehensive scientific experiments to find out about the differences in living organisms • Present findings of results, show comprehensive information about the differences between living organisms.	• Carry out a focused and detailed search into an agreed chemical concept using own and given sources. • Follow instructions to prepare a product by setting up and using chosen apparatus correctly, demonstrating competent housekeeping skills	• Carry out a focused and detailed search into an agreed aspect of physics using own and given sources. • Construct a comprehensive electrical circuit and measure its effectiveness, using equipment and tools safely.	• Produce a comprehensive plan to make a chemical product. • Select and use effectively, practical skills and equipment to make a chemical product • Review own performance in making a chemical product, explaining its fitness for purpose and how it could be improved, and explaining how own performance could be further developed.	• Use appropriate procedures confidently to collect and analyse evidence from a simulated crime scene. • Produce detailed and valid conclusions drawn from crime scene evidence for a simulated crime scene. • Present conclusions effectively, selecting information from a wide range of procedures in a well-organised and logical format

Additonal Units		
Grade	**Making a Chemical Product**	**Pratical Actions to Protect the Enviroment**
Pass	• Produce an outline plan in preparation to carry out a scientific experiment. • Carry out a scientific experiment safely, following guidelines and procedures • Present an outline report of the results of a scientific experiment, using simple diagrams and data with annotations.	• Plan and implement some practical actions, taking some responsibility for own role within a team. • Communicate simple ideas about practical actions, outlining the scientific principles.
Merit	• Produce a detailed plan in preparation to carry out a scientific experiment • Carry out a scientific experiment safely and correctly. • Present a well-formatted report of the results of a scientific experiment, selecting the appropriate information.	• Plan and implement practical actions efficiently, taking appropriate responsibility for own role within a team. • Communicate relevant ideas about practical actions, using descriptions of scientific principles.
Distrinction	• Produce a detailed and coherent plan to carry out a scientific experiment. • Carry out a scientific experiment safely and confidently. • Present a detailed report of the results of a scientific experiment in a well-organised and logical format, drawing simple conclusions.	• Plan and implement practical actions confidently, taking full responsibility for own role and making effective contributions. • Communicate complex ideas about practical actions, using explanations of the wider scientific principles.

Science Flight Path

In Science we have high expectations for our pupils and we use the flight path created for Maths across the Trust to judge the progress of our pupils each term. Once a pupil has been baselined, teachers calculate their expected progress using the flight path and reports each term whether pupils are meeting their expected progress, exceeding, or have not met. Pupils who do not meet their expected target level in Science are offered additional support.