SCIENCE/GCSE COMBINED SCIENCE

Why is the study of Science important?

Have you ever wondered why the sky is blue? If there are more than 118 elements? Whether there are more undiscovered species of plant or animal? What would the nearest adult answer if you posed these questions? Could they be answered by the brightest minds in science? The curiosity that lies behind these questions and the drive to find the answers is what makes us human and it lies in the heart of Science.

Answering questions is essentially the whole purpose of science and answering these questions simply brings more questions to the surface. Great scientists, those at the very frontier of what we understand as science knowledge, would still declare that the more we understand about the universe, the more there is to find out. How great is that?

The concise Oxford dictionary defines science as 'systematic and formulated knowledge' that is based on mainly observation, experiment and induction'. Science consists of the interrelated discipline of knowledge (substantive knowledge) and skills (disciplinary knowledge) - but those of us who have ever questioned the world around us see it as so much more than that. Through science you can learn to develop your own ideas, attitudes and interpretations and not simply acquire a set of skills and knowledge. Throughout our science curriculum you'll see that science substantive and disciplinary knowledge are important but it's the application of these ideas that lead onto the great discoveries. Let's get to discovering…

Understanding the scientific process is a way of thinking and working. Science begins with curiosity and daring to ask questions, seek answers, work through problems and arrive at conclusions. All of which require logical thought and a systematic way of working. A process that is applicable to most scenarios in life! Want to think like a scientist?

Science is an active process. From Year 7 we have planned a range of relevant and exciting scientific activities that involve the full range of all the aspects of science. We feel that to be able to think like a scientist you must understand the foundations that led us to our current understanding in the 21 century. To support this, we have allowed the opportunity to recreate the investigations of key scientists and to encourage you to try out your own ideas, where the outcomes are unknown and to prove the validity of a scientific fact or idea.

Our curriculum focuses on intertwining core substantive knowledge with subject specific disciplinary knowledge. It is our conviction that this will make science accessible for all, by enabling students a strong foundation in learning a body of knowledge to the products and practices of science. This will then allow students to understand and appreciate how that knowledge was derived, how it came to be discovered and accepted by the scientific community. In science knowledge is power with it you can unlock scientific thinking and processes.

I challenge you to describe your journey today to the point where you are reading these words. Within seconds of waking up you have benefited from several products developed as a result of someone's curiosity. Science has provided solutions to a huge number of curiosities and problems, some with great importance (medicine, smart materials), some abstract (relativity, atomic theory) and some controversial (GM foods, radioactivity).

If you read the poem *The Learn'd Astronomer* by Walt Whitman you'll appreciate that whilst celebrating the contribution that science has made to our lives, we should never be lost in facts, data and results. We must never lose sight of the beauty of our world beyond the analysis and to every now again observe 'the perfect silence in stars'. Science provides us with answers. Whilst these answers can be useful in feeding our curiosity they should also make us realise that the world around us is far more complex and beautiful than our imaginations could ever conceive.

'Not only is the universe stranger than we think, it is stranger than we can think' Werner Heisenberg

Many would argue that understanding the beauty of the universe is akin to a magician revealing their tricks. But by following our science curriculum you will appreciate understanding the phenomena makes it even more awe inspiring.

Curriculum pathways

From September 2021 we have taught a thematically based combined science approach in Year's 7 to 9 that ambitiously covers the national curriculum and topics beyond that we feel are important to our students lives. This approach has been constructed through the latest evidential research in regards to curriculum coherence and the ability to develop and map conceptual frameworks throughout the students' study that embed learning.

Students at the end of the KS3 programme will have the foundational knowledge to pursue either GCSE Combined Science pathway or the GCSE Separate Science pathway at KS4.

What skills will the study of Science/GCSE Combined Science teach you?

You are a citizen in this world and you need to know how the natural and modern world works. It will teach you to:

- Understand theories that explain phenomena
- Apply basic ideas and models that support understanding
- Evaluate models and theories
- Present theories in mathematical form
- Recall quantitative relationships
- Derive quantitative relationships between various measured quantities
- Explain how theories are borne out by experiment
- Apply experimental procedure and understand that it is a measure of success of a theory
- Present, interpret and evaluate experimental data
- Apply mathematical skills to solve problems
- Develop a deeper understanding of everyday experiences including the natural world and modern devices.

How does your study of Science/GCSE Combined Science support your study in other subjects?

Study of any subject in our curriculum takes full advantage of links with other subject areas- we term these as interdisciplinary links and we make the most of them because we know that deep learning requires the transference of knowledge and skills from one topic of learning to another. Once you can transfer your learning across topics and subject areas then you are really mastering what you know and how to apply your understanding and skills.

Science encompasses Biology, Chemistry and Physics. You will learn methods of thinking and research that are widely applicable to other subject areas helping your thinking in all subjects. Any Science relies heavily upon evidence to test predictions and theories. Through developing

mathematical techniques as well as applying reasoning your skills to present and justify information can be applied to most careers and further education.

Across the teaching of subjects, teachers will refer to your learning in other areas such as Biology, Mathematics, Physics and Chemistry and this will help you to develop your understanding.

How are you assessed in Science/GCSE Combined Science?

Throughout the 5 yr science curriculum you are assessed using the below assessment objectives which ensure that you can cumulatively build your subject understanding in preparation for future GCSE and A Level study. There are regular assessment points each year that we term Praising Stars©. At GCSE we make informed predictions informed by our holistic assessment of your progress against the key assessment objectives and your aspirational GCSE targets. These are also the basis for any appropriate support and intervention.

KS3 Assessments

Each unit in KS3 will be assessed with a summative test that is split into 4 sections; (a and b) substantive knowledge of the learnt unit in the form of short answer and MCQ's; (c) disciplinary knowledge related to the learnt unit and (d) substantive knowledge of previous learnt units.

Key Assessment Objectives at KS3 for Disciplinary Knowledge Strand

Disciplinary Knowledge Strand	Sub-Strand	Degree	Core Disciplinary Knowledge
Analysing in Science	Patterns	1	Calculate a mean from a set of data Read values from a line graph
		2	Spot a data point that does not fit the pattern. Identify the variables from information about an investigation.
		3	Estimate values of data between known values. Calculate parts of pie Identify a pattern in data from a results table or bar chart.
		4	Compare your results to someone else's Express a linear relationship between variables in the form 'When... doubles then... also doubles'
	Limitations	1	Identify variables that you could not control properly. Identify aspects of the method that did not go according to plan.
		2	Suggest better ways to control variables. Suggest ways to improve the method.
		3	Suggest reasons for differences in repeat readings. Suggest ways to reduce measurement errors.
		4	Comment on whether your findings fit with known scientific explanations. Research other possible scientific explanations for your conclusion.
	Conclusions	1	Incorporate the pattern you found into an answer to the investigation question.
		2	Suggest a scientific reason for your findings.
		3	Suggest explanations for anomalous results
		4	Suggest other possible conclusions that could be drawn from your data. Quote any secondary data you have which led to the same conclusion.
	Present Data	1	Record data in a table (pre-made) Label the x axis with the name of the independent variable and the y axis with the dependent variable. Write unit labels on the axes.
		2	Draw a straight line or a curve of best fit through the points. Plot points on a scatter graph or draw bar charts
		3	Decide the type of chart or graph to draw based on its purpose or type of data. Decide which numbers to start and finish with on each axis. Produce labels with units for a table Transferring data onto Pie-chart
		4	Design a table for the data being gathered Mark out an equal scale showing what each square of graph paper represents.

Communicating in Science	**Constructing explanations**	1	Record the observation you want to explain.
			Record observations using scientific words.
		2	Use a diagram that might help the explanation.
			Suggest a scientific idea that might explain the observation.
		3	Describe the evidence for your idea.
		4	Explain why the evidence supports your idea.
	Critique Claims	1	Identify the claim.
			Comment on whether the claim is clearly stated.
		2	Identify all the evidence that is used.
		3	Comment on whether the evidence is scientifically accurate and relevant to the claim.
		4	Identify the reasoning that links the evidence to the claim.
			Comment on whether the reasoning follows logically from the evidence.
	Justify opinions	1	State the issue or decision to be made, along with the options.
			State your opinion with enough detail to be clear.
		2	List all the facts, scientific ideas, data, or conclusions that support your opinion.
		3	Identify the most important piece of evidence, as well as one or two supporting pieces of evidence.
		4	Explain logically how each piece of evidence supports your opinion.
			Explain why each piece of evidence does not support other opinions.

Investigating in Science	**Collect data**	1	Gather sufficient data for the investigation and repeat if appropriate.
			Use the measuring instrument correctly
			Carry out the method carefully and consistently.
		2	See if repeated measurements are close.
			Choose a suitable range for the independent and dependent variable.
			Read equipment scales correctly
		3	Remove outliers and calculate mean of repeats.
		4	Check that the measuring instrument can measure the complete range of the independent variable.
			Check you can detect differences in the dependent variable.
	Devise questions	1	Identify an observation that could be recorded or measured over time.
		2	Identify a dependent variable.
			Identify an independent variable.
		3	Write a question in the format 'How does... change over time?'
			Write a question linking variables in the form 'How does... affect...?'
			Identify two variables which may show a correlation.
		4	Write a question in the form 'Is there a correlation between... and...'
	Plan variables	1	Decide how to vary the independent variable between planned values.
		2	List all the variables that could affect the dependent variable.
			Decide how to measure the dependent variable
		3	Select important control variables.
		4	Identify how to control each control variable.
			List variables you cannot control.
	Test Hypotheses	1	Identify and record key features of an observation.
			Write a scientific description of the observation, using key words.
		2	Suggest a hypothesis for the observation.
		3	Suggest an experiment to test the hypothesis.
			Predict what will happen if your hypothesis is correct.
		4	Decide whether the conclusion of the experiment agrees with your prediction
			State whether or not the hypothesis is correct.
	Risk/Hazard	1	Identify features of an investigation which are hazardous.
			Determine the nature of the hazard.
		2	Suggest the likelihood of that happening.
		3	Identify ways of reducing the risk.
		4	Weigh up the benefits and risks of an application of science to make a decision.
			Explain why you made this decision.
	Writing a practical method	1	Sequence a practical method
			Drawing scientific diagrams of the equipment and practical set up
		2	Identifying the key elements to include in a written method (MARV)
			Writing a simple method from given equipment
		3	Writing a simple method choosing own equipment
		4	Writing a method that specifies values for IV, DV, CV.

Application of Science	**Examine consequences**	1	State how each group could benefit or be harmed.
			Describe possible consequences to the environment, including habitats, air quality, organisms etc.
		2	Identify groups who could benefit or be harmed positively or negatively by a new discovery or invention.
			Identify individuals or organisations who may gain or lose money from a new technology.
		3	Describe/Explain how each group could benefit or be harmed.
			Describe how it would affect each group financially.
		4	Predict views that different groups will take on the new discovery or invention.
			Describe potential impacts further afield.
	Review theories	1	Explain what is meant by a theory.
			State examples of theories in science.
		2	State examples of theories that have changed.
		3	Describe the role of evidence in supporting theories.
			Explain role of new evidence in changing theories.
		4	Explain role of argumentation in modifying theories.
	Interrogate sources	1	The experimenter collected enough data
		2	The authors of the research are qualified scientists
			The research was published in a peer reviewed journal
		3	They gave a scientific explanation of the findings
			The research agrees with current scientific thinking
		4	The researcher, author or funder might benefit from reporting the finding (bias, vested interest)
			The findings were backed up by other research.

Maths in Science	1	SI Units
		Mode and Median
		Range
		Area
	2	Volume
		Simple unit converstions
		Identify values required for simple equations
	3	Calculating Percentages
		Rounding of decimal numbers
		Significant figures
		Substitute values into simple equations
	4	Surface Area
		Estimating
		Calculating values from percentages

Key Assessment Objectives for GCSE Combined Science

AO1: Demonstrate knowledge and understanding of:

- Scientific ideas
- Scientific techniques
- Scientific procedures

AO2: Apply knowledge and understanding of:

- Scientific ideas
- Scientific enquiry
- Scientific techniques and procedures

AO3: Analyse information and ideas to:

- Interpret and evaluate
- Make judgements and draw conclusions
- Develop and improve experimental procedures.

How can GCSE Combined Science support your future?

Science can support your future through any of the 3 major subject branches.

Biology

We offer the study of GCSE and A Level Biology/BTEC Applied Human Biology/WJEC Medical Science/BTEC Forensic Science (in our Post 16 academies) and we encourage your continued study in this fantastic subject. Biology is offered at most prestigious universities either as a single honours or a joint honours subject studied alongside other disciplines e.g. English literature. The very fact that you have been able to study Biology, your analytical thinking and mathematical reasoning will help your future application be they for: colleges, universities, apprenticeships or employment. All Science Level 2 (GCSE) and Level 3 (Post 16) are facilitating subjects, they are highly sought after by employers and universities.

Careers that the study of Biology supports include

- Medicine/Nursing/Dentistry/Veterinary
- Marine Biology
- Geneticist/Genomicist
- Nanotechnology
- Biostatistician
- Science journal editor
- Law

Chemistry

We offer the study of GCSE and A Level Chemistry/BTEC Forensic Science and we encourage your continued study in this fantastic subject, yet we know that choice and personal interest are important aspects of worthy study. Whether you have continued your study of Chemistry into GCSE or A level or not you will have gained access to this enriching subject and its study will have taught you to think differently and deeply.

Chemistry is offered at most prestigious universities either as a single honours or a joint honours subject studied alongside other disciplines e.g. chemical engineering, veterinary sciences and medicine. The very fact that you have been able to study chemistry strengthens your analytical thinking and mathematical reasoning that will help your future application be they for colleges, universities, apprenticeships or employment. All Science Level 2 (GCSE) and Level 3 (Post 16) are facilitating subjects, they are highly sought after by employers and universities.

Careers that the study of Chemistry supports include:

- Medicine
- Veterinary science
- Chemical Engineering
- Forensic Science
- Biochemistry
- Pharmacy
- Product development scientist (for example developing makeup and personal care products)

Physics

Physics is offered at most prestigious universities either as a single honours or a joint honours subject studied alongside other disciplines e.g. Engineering, Mathematics, Astronomy. The very fact that you have been able to study Physics and your analytical thinking and mathematical reasoning will help your future application be they for colleges, universities, apprenticeships or employment. All Science Level 2 (GCSE) and Level 3 (Post 16) are facilitating subjects; they are highly sought after by employers and universities.

Careers that the study of Physics supports include:

- Medicine
- Engineering (electrical, software, medical, civil, mechanical)
- Geophysics
- Scientific research and development
- Product design
- Aeronautical engineering
- Construction
- Architecture
- Civil or medical engineer,
- Astrophysics
- Astronomer

KS3 Science/GCSE Combined Science Curriculum Progression Pathway

Current Y7/8 (24+)		Science KS3 Curriculum 24+			
		Y7	Y8		Subject Key
Autumn	HT 1	Introduction to Science (KS2 Recap/Getting ready for KS3)	Plants, Ecology & Climate Change	Forces	Biology
	HT 2	Matter & Energy	Chemical Reactions		Chemistry
Spring	HT 1	Chemical Substances	Cells, Reproduction and Inheritance		Physics
	HT 2	Animal Organ Systems	Waves		
Summer	HT 1	Space, Earth & Sustainability	Electromagnetism and Electricity		
	HT 2	Plants, Ecology & Climate Change	Patterns & Materials		

The Y9 timelines are individualised by academy depending on pathways and tiers. The timeline has specialist rotations, the general timeline is below.

Current Y9 (24+)		Science KS3/KS4 Transition Year		Subject Key
		Y9		Biology
Autumn	HT 1	End of KS3 Assessments	Health & Disease	Chemistry
	HT 2	C1 - Atomic structure	B1 - Cell biology	Physics
Spring	HT 1	B1 - Cell biology	P1 - Energy	
	HT 2	C2 - Bonding & structure	B2 - Organisation	
Summer	HT 1	B2 - Organisation	C2 - Bonding & structure	
	HT 2	P2 - Electricity	B3 - Infection & response	

The Y10 timelines are individualised by academy depending on pathways and tiers. The timeline has specialist rotations, the general timeline is below.

Y10/11 (24+)		KS4 GCSE Science 24+					
		Y10			Y11		
Subject		Bi	Ch	Ph	Bi	Ch	Ph
Autumn	HT 1	B4 - Bioenergetics	C3/C4 - Quantitative Chemistry/ Chemical Change	P3 - Particle model of matter	B7 - Ecology	C9/C10 - Atmosphere and resources	P8 - Space (Triple Only)
	HT 2	B5 - Homeostasis	C5 - Energy Changes	P4 - Atomic structure	Paper 2 Assessments		
Spring	HT 1	Paper 1 Assessments & Gap fill			Masterclasses		
	HT 2	B6 - Inheritance	C6 - Rates of reaction	P5 - Forces	Masterclasses		
Summer	HT 1	B7 - Ecology	C7 - Organic Chemistry	P6 - Waves	Exams		
	HT 2	B7 - Ecology	C8 - Analysis	P7 - Electromagnetism			

Current Y11 (24)		KS4 GCSE Science 24		
		Y11		
Subject		Bi	Ch	Ph
Autumn	HT 1	B6 - Inheritance	C6/C7 - Rates of Reaction/ Organic Chemistry	P5/P6 - Forces/ Waves
	HT 2	Paper 1 Assessments		
Spring	HT 1	B7 - Ecology	C8/C9/C10 - Analysis/-Atmosphere/ Resources	P7/ P8 - Electromagnetism/ SPace (Triple only)
	HT 2	Paper 2 Assessments		
Summer	HT 1	Exams		
	HT 2			