

Science Curriculum Intent

Biology GCSE



At New Line Learning Academy, the Year 11 curriculum is designed to develop curious, analytical and scientifically literate students who understand the living world and their place within it. Through the study of Biology, Chemistry and Physics, students explore the complexity of life from microscopic cells to global ecosystems, developing an appreciation of how living organisms function, interact and evolve. The curriculum encourages students to ask questions, think critically and evaluate evidence, enabling them to make informed decisions about health, the environment and the scientific issues that shape modern society.

The curriculum begins with the fundamental building blocks of life, exploring cell structure, transport processes and biological organisation before progressing to the systems that enable organisms to survive and reproduce. Students investigate disease, immunity and medical advances before developing an understanding of photosynthesis, respiration and the transfer of energy through living systems. They then study homeostasis, genetics, evolution and ecology, recognising the interconnected nature of biological processes and the impact humans have on the natural world.

Throughout the curriculum, substantive knowledge is carefully sequenced alongside disciplinary knowledge. Students develop practical laboratory skills, learn to plan and evaluate investigations, interpret data, identify patterns, analyse graphs and apply mathematical techniques to biological contexts. They learn to think and communicate like scientists by constructing evidence-based explanations, evaluating the reliability of scientific evidence and applying their knowledge to unfamiliar situations.

The Biology curriculum places significant emphasis on the relevance of science beyond the classroom. Students explore contemporary issues including genetic engineering, stem cell research, vaccination, antibiotic resistance, conservation, biodiversity and climate change. These authentic connections encourage students to consider the ethical, social and environmental implications of scientific developments while recognising the important role Biology plays in improving lives and protecting our planet.

Learning is enriched through required practical investigations, retrieval practice, explicit vocabulary instruction, teacher modelling and opportunities for collaborative enquiry. Students are encouraged to become increasingly independent learners who can confidently explain complex biological concepts, interpret scientific evidence and solve problems using logical and critical thinking.

This means that all students leave the Biology curriculum able to:

- explain how living organisms are structured, function and interact at every level of organisation,
- apply biological knowledge confidently to unfamiliar scientific and real-world contexts,
- plan, carry out and evaluate practical investigations using appropriate scientific methods,
- analyse, interpret and evaluate biological evidence, data and graphical information,
- communicate scientific ideas accurately using precise biological vocabulary,
- understand the importance of Biology in medicine, healthcare, biotechnology and environmental conservation,
- appreciate the ethical, social and environmental implications of modern biological research, and

- develop the curiosity, resilience and critical thinking skills required for further study and future careers in science.

Topic 1

Topic



C2 – Bonding, Structure and the Properties of Matter



Big Picture

What are the main ideas and big questions in this topic?

Everything around us is made from substances with unique properties, from the flexibility of plastics and the strength of metals to the hardness of diamonds and the conductivity of graphite. Understanding why substances behave differently begins with understanding how atoms bond together. This enquiry explores how chemical bonding determines the structure and properties of materials, enabling students to explain the behaviour of familiar substances and appreciate how chemists design new materials for an ever-changing world.

Students investigate how ionic, covalent and metallic bonding give rise to different structures and properties, developing an understanding of the relationship between the microscopic world of atoms and the macroscopic properties of materials. Through practical investigation, modelling and scientific reasoning, students begin to explain why substances behave as they do and how this knowledge is applied across science, engineering and industry.



Zoom In

What knowledge, skills and key vocabulary will we learn step by step?

The enquiry begins by introducing the concept of chemical bonding, exploring why atoms bond together to achieve greater stability. Students develop the substantive knowledge required to distinguish between ionic, covalent and metallic bonding, understanding how electrons are transferred or shared to form different substances. Teacher modelling explicitly demonstrates how bonding diagrams, dot and cross diagrams and structural models help chemists visualise interactions that cannot be seen directly.

Students develop disciplinary knowledge by interpreting models, constructing bonding diagrams and evaluating how different representations help explain chemical behaviour. Practical activities and modelling tasks encourage students to make links between atomic structure, bonding and the observable properties of substances.

Attention then turns to the different structures of matter, including giant ionic lattices, simple molecular substances, giant covalent structures and metallic lattices. Students investigate how these structures influence melting point, boiling point, conductivity, hardness and solubility, explaining why substances with different bonding display contrasting physical properties.

As the enquiry progresses, students compare familiar materials such as diamond, graphite, graphene and metals, evaluating why they are suited to particular applications. They apply scientific models to explain the properties of new materials and develop mathematical and analytical skills through interpreting scientific data and identifying patterns.

Throughout the enquiry, specialist vocabulary including ionic bond, covalent bond, metallic bond, lattice, molecule, giant covalent structure, delocalised electrons, conductivity, intermolecular forces and polymer is explicitly taught and revisited through retrieval practice, modelling, practical investigation and extended scientific writing.

The enquiry concludes by challenging students to explain how atomic bonding determines the properties of substances and why understanding these relationships has enabled scientists to develop innovative materials that improve everyday life.

	Pre-Requisite Knowledge <i>What have we already learned that will help us with this topic?</i>		Pitch Up <i>How will we challenge ourselves?</i>
	Students build upon their understanding of atomic structure, electronic arrangement and the Periodic Table developed in C1. They apply their knowledge of electrons and atomic structure to explain how atoms interact and form the substances encountered throughout the remainder of the Chemistry curriculum.		Students are challenged to move beyond simply identifying different bond types by explaining how bonding influences the physical properties of substances using scientific models and evidence. They compare structures, evaluate materials for different applications and justify why particular substances are suited to specific purposes. Stretch is embedded through interpreting complex structural diagrams, explaining the properties of giant covalent structures such as graphene and evaluating the development of advanced materials. Students are encouraged to appreciate how an understanding of bonding has transformed engineering, medicine and technology.
	Wider Framework <i>How does this learning connect to future topics and bigger goals?</i>		Curriculum Hinterland <i>What wider knowledge will deepen our understanding of this topic?</i>
	This enquiry forms a core component of the AQA GCSE Chemistry specification and provides the foundation for understanding chemical reactions, energy changes and material science. Students develop: - Substantive knowledge of ionic, covalent and metallic bonding, material structures and the relationship between bonding and physical properties. - Disciplinary knowledge through modelling, scientific explanation, interpretation of evidence, practical investigation and analytical reasoning.		Students explore the work of scientists including Gilbert Lewis, Linus Pauling and Dorothy Hodgkin, whose discoveries transformed our understanding of chemical bonding, molecular structure and crystallography. The enquiry also investigates contemporary developments including graphene technology, advanced alloys, biodegradable polymers, nanomaterials and superconducting materials, demonstrating how chemistry continues to drive scientific innovation across medicine, engineering and sustainable technologies.

Students also strengthen scientific literacy through the interpretation of diagrams and models whilst developing mathematical thinking by analysing patterns and comparing data relating to material properties.



Authentic connections

How does this topic connect to real life, careers, other subjects and important values?

The study of Bonding, Structure and the Properties of Matter enables students to appreciate how the arrangement of atoms determines the characteristics of every material they encounter. Students develop spiritual understanding by recognising the remarkable organisation of matter at the atomic scale and reflecting upon how microscopic interactions create the diverse materials that shape the natural and human-made world.

Social and cultural understanding develops through exploring how advances in material science have transformed construction, healthcare, transport and communication. Moral understanding is strengthened as students evaluate the environmental impact of developing, using and disposing of modern materials, considering how chemistry contributes to more sustainable solutions for future generations.

This enquiry has strong explicit links with Physics, where students investigate particle behaviour, forces and material properties. It supports Design and Technology by exploring how the structure of materials influences their suitability for different engineering and manufacturing applications. Students apply Mathematics when interpreting diagrams and recognising patterns in atomic structures, whilst English is developed through scientific explanation and justification using accurate subject-specific vocabulary.

This enquiry explicitly develops the following Skills Builder Universal Framework competencies:

- Creativity – Students apply their understanding of bonding to explain the properties of unfamiliar substances and evaluate innovative materials.
- Teamwork – Students collaborate during modelling activities and practical investigations, sharing ideas and refining scientific explanations together.
- Problem Solving – Students interpret evidence, identify patterns and explain how atomic structure influences the observable properties of substances.



This enquiry provides authentic insight into careers including:

- Materials Engineer – Designing materials with specific properties for construction, aerospace and manufacturing.
- Polymer Scientist – Developing plastics, biodegradable materials and advanced composites.
- Nanotechnology Researcher – Investigating materials at the atomic scale to create new technologies for medicine, electronics and energy.

Students recognise that the scientific modelling, analytical reasoning and collaborative problem-solving developed throughout this enquiry are highly transferable across STEM disciplines and many wider professional careers.



Resources

What books, websites, videos and materials will support our learning?



Assessment

How will we show what we know, remember and can apply?

Teaching and learning throughout this enquiry are supported through a range of practical, digital and contextual resources that develop scientific understanding through modelling, investigation and application.

- Teacher modelling, live demonstrations and visualisers to explicitly teach bonding and structural models.
- Molecular model kits, dot and cross diagram activities and crystal lattice models.
- Practical investigations exploring conductivity, melting points and the physical properties of substances.
- Retrieval activities, dual-coded diagrams and subject-specific vocabulary displays.
- Case studies exploring graphene, polymers and advanced engineering materials.
- AQA GCSE Chemistry specification guidance.
- Digital resources including:
 - Cognito
 - Kerboodle
 - BBC Bitesize GCSE Chemistry
 - Oak National Academy
 - Royal Society of Chemistry

Students complete retrieval activities assessing prior understanding of atomic structure, electronic arrangement and the Periodic Table. Diagnostic questioning identifies misconceptions about electron transfer and sharing before new learning begins.

Students construct and interpret dot and cross diagrams, compare different types of bonding and explain how structure influences physical properties using scientific models and practical evidence.

Students complete a cumulative assessment requiring them to explain ionic, covalent and metallic bonding, interpret structural diagrams, compare material properties and apply their understanding to unfamiliar substances and real-world applications.

XX% Substantive Knowledge

Students demonstrate knowledge and understanding of:

- Ionic, covalent and metallic bonding.
- Electron transfer and electron sharing.
- Dot and cross diagrams.
- Giant ionic, simple molecular, giant covalent and metallic structures.
- The relationship between bonding, structure and physical properties.
- The uses and properties of materials including diamond, graphite, graphene and metals.

XX% Disciplinary Knowledge

Students demonstrate their ability to:

- Construct and interpret bonding and structural diagrams.
- Explain how atomic structure determines the properties of substances.
- Analyse scientific models and evaluate their strengths and limitations.
- Interpret data relating to material properties and identify patterns.
- Apply scientific understanding to unfamiliar materials and justify conclusions using evidence.
- Communicate scientific explanations using accurate subject-specific vocabulary.

Topic 2

Topic



P3 – Particle Model of Matter



Big Picture

What are the main ideas and big questions in this topic?

The particle model is one of the most powerful ideas in science, allowing scientists to explain the behaviour of solids, liquids and gases using the movement and arrangement of particles that cannot be seen with the naked eye. From understanding why substances change state to explaining pressure, density and thermal energy, the particle model provides the foundation for much of modern physics, chemistry and engineering.

This enquiry develops students' understanding of how matter behaves by exploring the relationship between particles, energy and temperature. Through practical investigation and scientific modelling, students learn how microscopic particle behaviour explains observable changes in the world around them. This knowledge provides an essential foundation for later study of pressure, radiation, thermodynamics and materials science.



Zoom In

What knowledge, skills and key vocabulary will we learn step by step?

The enquiry begins by introducing the particle model as a scientific explanation for the behaviour of solids, liquids and gases. Students develop the substantive knowledge required to describe how particles are arranged, how they move and how their behaviour changes as energy is transferred into or out of a substance. Students recognise that scientific models provide simplified explanations that help scientists understand phenomena that cannot be observed directly.

Teacher modelling explicitly demonstrates how particle diagrams are used to represent changes of state, diffusion and internal energy. Students develop disciplinary knowledge by interpreting scientific models, analysing evidence from practical investigations and evaluating how well models explain observed phenomena. Practical work encourages students to collect accurate measurements, identify patterns and use evidence to support scientific explanations. Attention then turns to the relationship between temperature, internal energy and changes of state. Students investigate melting, freezing, evaporation, condensation and boiling, recognising that energy transferred to particles increases their internal energy and changes their motion rather than simply increasing temperature. Through experimental investigation, students explore heating and cooling curves, identifying how energy is transferred during changes of state.

As the enquiry progresses, students investigate density and pressure, applying their understanding of particle behaviour to explain why substances behave differently under varying conditions. They analyse relationships between particle movement, pressure and volume in gases whilst interpreting graphical data and applying mathematical calculations involving density. Students strengthen their understanding through required practical activities, developing confidence in measurement, data analysis and evaluation.

Throughout the enquiry, specialist vocabulary including particle model, internal energy, density, pressure, specific heat capacity, latent heat, melting, boiling, condensation, evaporation and diffusion is explicitly taught and revisited through retrieval practice, practical work, discussion and extended scientific writing. The enquiry concludes with students applying the particle model to explain increasingly complex scientific phenomena, evaluate practical investigations and solve quantitative problems involving density and thermal energy. By combining theoretical understanding with practical investigation and mathematical reasoning, students develop a secure foundation for future learning across GCSE Physics.

	Pre-Requisite Knowledge <i>What have we already learned that will help us with this topic?</i>		Pitch Up <i>How will we challenge ourselves?</i>
	Students begin this enquiry with prior knowledge from Key Stage 3, including the properties of solids, liquids and gases, simple changes of state and the effects of heating and cooling. They also build upon their understanding of energy transfers developed in the Energy enquiry, recognising that heating transfers energy into materials and affects particle behaviour.		This enquiry challenges students to move beyond simply describing changes of state towards explaining them using particle theory and scientific evidence. Students are expected to apply the particle model to unfamiliar situations, interpret graphical data and justify explanations using precise scientific reasoning. Stretch is embedded through the interpretation of heating curves, mathematical calculations involving density and pressure, and evaluation of experimental evidence. Students are encouraged to appreciate that scientific models are continually refined as new evidence emerges and to think critically about both the strengths and limitations of models used within physics. Students are encouraged to think like physicists by using invisible particle behaviour to explain observable events, recognising the importance of modelling in advancing scientific understanding.
	Wider Framework <i>How does this learning connect to future topics and bigger goals?</i>		Curriculum Hinterland <i>What wider knowledge will deepen our understanding of this topic?</i>
	This enquiry forms part of the AQA GCSE Physics specification and provides essential knowledge for later study of thermal physics, radiation, pressure and the behaviour of gases. Students develop: • Substantive knowledge of particle behaviour, changes of state, density, pressure and internal energy. • Disciplinary knowledge through practical investigation, scientific modelling, mathematical application, data analysis and evidence-based scientific reasoning. Students also strengthen numeracy through density calculations and graph interpretation, literacy through scientific explanation and oracy through collaborative practical work and scientific discussion.		Students deepen their understanding by exploring how the particle model developed through the work of scientists including John Dalton, Albert Einstein and Ludwig Boltzmann, whose research transformed our understanding of matter at the atomic and molecular scale. The enquiry also explores contemporary applications including refrigeration, cryogenics, advanced materials, space exploration and the storage of liquefied gases, demonstrating how understanding particle behaviour continues to drive scientific innovation across medicine, engineering and industry.



Authentic connections

How does this topic connect to real life, careers, other subjects and important values?

The study of the Particle Model of Matter provides meaningful opportunities for students to appreciate how scientific models allow us to explain processes that cannot be directly observed. Students develop spiritual understanding through recognising the remarkable complexity of the microscopic world and appreciating how simple scientific principles explain many of the natural phenomena experienced in everyday life.

Social and cultural understanding is strengthened through exploring how advances in materials science and thermal technologies have improved healthcare, transport and food preservation across the world, whilst moral understanding develops through considering the environmental impact of refrigeration, industrial processes and energy consumption. Students recognise the importance of scientific innovation in developing more sustainable technologies for the future.

This enquiry explicitly develops the following Skills Builder Universal Framework competencies:

- Problem Solving – Students apply particle theory to explain unfamiliar scientific phenomena and evaluate experimental evidence.
- Creativity – Students use scientific models to visualise and explain processes that cannot be directly observed.
- Speaking – Students communicate scientific explanations, justify conclusions and evaluate the strengths and limitations of scientific models using accurate terminology.



This enquiry provides authentic insight into careers including:

- Materials Scientist – Developing new materials with specific properties for use in engineering, medicine and technology.
- Chemical Engineer – Applying knowledge of particle behaviour, temperature and pressure within industrial manufacturing processes.
- Cryogenics Engineer – Designing systems that use extremely low temperatures for applications including medicine, scientific research and space technology.

Students recognise that the modelling, analytical thinking, mathematical reasoning and problem-solving skills developed throughout this enquiry are highly valued across science, engineering and many other professional industries.



Resources

What books, websites, videos and materials will support our learning?

Teaching and learning throughout this enquiry are supported through a range of practical, digital and contextual resources that develop scientific understanding through modelling and investigation.

- Teacher modelling, live demonstrations and visualisers to explicitly teach particle theory, density calculations and graphical interpretation.



Assessment

How will we show what we know, remember and can apply?

Students complete retrieval activities assessing prior understanding of solids, liquids, gases, changes of state and energy transfers whilst identifying misconceptions that will be addressed throughout the enquiry.

- Practical investigations exploring changes of state, density, heating and cooling.
- Laboratory equipment including measuring cylinders, balances, thermometers and density apparatus.
- Particle model animations, simulations and dual-coded diagrams to support conceptual understanding.
- Retrieval activities and subject-specific vocabulary displays.
- AQA GCSE Physics specification guidance and required practical resources.
- Digital resources including:
 - Oak National Academy Physics
 - BBC Bitesize GCSE Physics
 - Institute of Physics
 - National STEM Learning Centre
 - AQA GCSE Physics

Students complete a practical investigation exploring changes of state or density, demonstrating their ability to collect reliable data, identify patterns and explain observations using the particle model.

Students complete a cumulative assessment requiring them to explain particle behaviour, interpret graphs, calculate density and apply their understanding to unfamiliar scientific contexts.

XX% Substantive Knowledge

Students demonstrate knowledge and understanding of:

- The particle model of solids, liquids and gases.
- Internal energy and changes of state.
- Density and pressure.
- Specific heat capacity and latent heat.
- Heating and cooling curves.
- The strengths and limitations of scientific models.

XX% Disciplinary Knowledge

Students demonstrate their ability to:

- Use particle models to explain observable phenomena.
- Plan, conduct and evaluate practical investigations.
- Calculate density and interpret graphical data.
- Analyse experimental evidence and identify patterns.
- Construct scientific explanations using accurate terminology.
- Apply scientific understanding to unfamiliar contexts and justify conclusions using evidence.

Topic 3

Topic



B3 - Infection and Response



Big Picture

What are the main ideas and big questions in this topic?

Pathogens are microorganisms, including bacteria, viruses, fungi and protists, that cause infectious diseases in animals and plants. Throughout this topic, students investigate how pathogens spread, how the body prevents infection through physical and chemical barriers and how the immune system responds when pathogens enter the body. Students explore how vaccination has transformed public health, how antibiotics have revolutionised medicine and why antibiotic resistance presents one of the greatest challenges facing modern healthcare. They also investigate the development and testing of medicines, including monoclonal antibodies, and examine how plants defend themselves against disease, recognising the continual relationship between scientific discovery and improving global health.



Zoom In

What knowledge, skills and key vocabulary will we learn step by step?

Students begin by investigating pathogens, learning to distinguish between bacteria, viruses, fungi and protists whilst exploring how infectious diseases spread between plants and animals. They investigate methods of reducing transmission and develop practical skills by safely culturing microorganisms and interpreting patterns of microbial growth.

Students then explore the immune system, investigating the body's physical and chemical barriers, the role of white blood cells, antibodies and antitoxins, and how vaccination provides immunity through individual protection and herd immunity. Students consider how antibiotics treat bacterial infections, why they are ineffective against viruses and how antibiotic resistance has become a significant global challenge.

The topic continues with the development of medicines, where students investigate painkillers, Fleming's discovery of penicillin, the stages of drug testing and clinical trials, including the use of placebos and double-blind trials. Higher tier students extend their understanding by investigating monoclonal antibodies, their production, medical applications and current limitations. Students conclude by investigating plant diseases and plant defences, exploring viral, fungal and insect pathogens before considering the physical and chemical adaptations that enable plants to resist infection.

Core Knowledge (Substantive)

Students develop secure knowledge and understanding of:

- pathogens and infectious disease
- bacterial, viral, fungal and protist infections
- culturing microorganisms safely
- the body's first line of defence
- the immune system, antibodies and antitoxins
- vaccination and herd immunity
- antibiotics and antibiotic resistance
- drug discovery, development and clinical trials
- monoclonal antibodies (Higher Tier)
- plant diseases and plant defence mechanisms.
- Working Scientifically

Students develop their ability to **(Disciplinary):**

- culture microorganisms safely using aseptic techniques
- investigate the effects of disinfectants and antibiotics
- calculate inhibition zones and interpret quantitative data
- analyse scientific evidence from medical investigations
- evaluate the effectiveness of treatments and preventative measures
- interpret graphs, tables and experimental results

- communicate biological explanations using accurate scientific terminology.

Key Vocabulary: pathogen, bacteria, virus, fungus, protist, infection, transmission, toxin, immune system, white blood cell, antibody, antigen, antitoxin, vaccination, herd immunity, antibiotic, antibiotic resistance, aseptic technique, agar, incubator, disinfectant, placebo, double-blind trial, monoclonal antibody, immunity

	Pre-Requisite Knowledge <i>What have we already learned that will help us with this topic?</i>		Pitch Up <i>How will we challenge ourselves?</i>
	Students should already understand that microorganisms can cause disease, that bacteria and viruses differ in structure and reproduction, and that white blood cells help defend the body against infection. They should know that vaccines provide protection against disease and that medicines can be used to treat illness. Students should also have experience of carrying out practical investigations safely, recording observations and interpreting scientific evidence. This prior learning provides the foundation for investigating infection, immunity and medical treatments in greater depth.		Pupils are expected to attend science lessons on time, well equipped, ready to take risks and be active learners. Teachers will also introduce case studies and role-play activities, such as simulating a vaccine development team, diagnosing and prescribing medications or diagnosing autoimmune disorders, to help students apply their knowledge in meaningful contexts. Differentiated tasks, such as designing a new immune cell or evaluating the ethics of immunotherapy, ensure all learners are challenged at their level. Teachers will provide opportunities for pupils to debate ethical issues surrounding vaccination, animal testing and placebos.
	Wider Framework <i>How does this learning connect to future topics and bigger goals?</i>		Curriculum Hinterland <i>What wider knowledge will deepen our understanding of this topic?</i>
	Understanding infection and response provides the foundation for further study of homeostasis, inheritance, variation and evolution, and ecology. Students build upon their understanding of cells and biological organisation to explain increasingly complex interactions between pathogens, the immune system and medical treatments. Throughout the topic, students continue to develop the analytical, mathematical and practical skills required for GCSE examinations and further scientific study. The practical investigations undertaken throughout this topic strengthen students' ability to interpret scientific evidence, evaluate experimental methods, analyse quantitative data and communicate scientific conclusions using accurate biological terminology.		Historical narratives: - The discovery of penicillin by Alexander Fleming. - The global impact of smallpox and its eradication through vaccination. - The story of Edward Jenner and the first vaccine using cowpox. Scientific intrigue: - How the immune system “remembers” pathogens. - The arms race between evolving bacteria and modern medicine. - The ethical debates around drug trials and placebo use. Real-world relevance: - Case studies of outbreaks (e.g. Ebola, COVID-19). - The role of public health campaigns in disease prevention. - How antibiotic misuse in farming contributes to resistance. Cross-curricular links: - History: pandemics and medical revolutions. - Geography: disease spread in different climates and regions. - RWV - Ethics: dilemmas in vaccine distribution and drug testing



Authentic connections

How does this topic connect to real life, careers, other subjects and important values?

Understanding infection and response enables students to explain how pathogens cause disease, how the immune system protects the body and how scientific research continues to improve human health. Knowledge of microbiology, immunity and medical treatments underpins modern healthcare, biotechnology and pharmaceutical research, helping students appreciate how scientific discoveries continue to save lives across the world. SMSC is developed through curiosity, responsibility and critical thinking as students evaluate scientific evidence relating to vaccination, antibiotic use and public health. Students consider ethical issues surrounding clinical trials, emerging medical technologies and the global responsibility to reduce the spread of infectious disease.

Cross-curricular links include Chemistry through medicines, pharmaceuticals and chemical compounds, Mathematics through interpreting clinical trial data, percentages and graphical analysis, Geography through disease transmission and global health, and PSHEE through hygiene, vaccination and responsible health choices.

Students explore careers including:

- Microbiologist – investigating microorganisms to understand disease and develop treatments.
- Immunologist – researching the immune system to improve vaccines and therapies.
- Clinical Trials Scientist – designing and analysing medical trials to ensure new medicines are safe and effective.

The topic supports the Skills Builder Universal Framework, particularly:

- Listening through evaluating scientific evidence and considering differing viewpoints.
- Planning through organising practical investigations and interpreting clinical evidence.
- Problem Solving through applying biological knowledge to unfamiliar medical and public health scenarios.



Resources

What books, websites, videos and materials will support our learning?

At New Line Learning Academy, we are committed to equipping our pupils with high-quality resources that extend learning beyond the classroom and empower them to take ownership of their scientific journey. To enrich and consolidate understanding, pupils have access to a range of carefully selected digital platforms and learning tools:

- Cognito (<https://cognitoedu.org/home>) – Offers engaging video tutorials, concise notes, and practice questions tailored to support mastery of scientific concepts across Key Stage 3 and beyond.
- BBC Bitesize (<https://www.bbc.co.uk/bitesize/levels/z4kw2hv>) – Provides accessible explanations, interactive activities, and revision materials, helping pupils consolidate learning and revisit key topics independently.



Assessment

How will we show what we know, remember and can apply?

Assessment takes place throughout the enquiry through retrieval practice, practical investigations, questioning, examination-style questions and independent application tasks. Students demonstrate their understanding by explaining how pathogens cause disease, interpreting data relating to vaccination and antibiotics, evaluating medical evidence, analysing scientific investigations and communicating biological ideas using accurate scientific terminology.

XX% Substantive Knowledge

Students demonstrate secure understanding of pathogens, communicable disease, the body's defence systems, vaccination, antibiotics, drug development, monoclonal antibodies and plant disease.

- Sparx Science – www.sparx-learning.com – the platform used for science homework which will be set each week and provide topics from two weeks previously. The expectation is that pupils will have 100% completion and 100% success
- Kerboodle (<https://www.kerboodle.com/users/login>) – Supports the curriculum with digital textbooks, assessments, and interactive resources aligned to national specifications, offering pupils and teachers a wealth of high-quality materials.
These resources not only reinforce classroom learning but also foster curiosity, independence, and confidence, ensuring every pupil can thrive and deepen their scientific understanding at their own pace.

XX% Disciplinary Knowledge

Students apply practical and investigative skills by interpreting scientific evidence, analysing data, evaluating investigations, considering the validity of medical claims and constructing evidence-based scientific conclusions.

Topic 4

Topic



C3 – Quantitative Chemistry



Big Picture

What are the main ideas and big questions in this topic?

Chemistry is not only about understanding what substances are made of, but also about measuring how they react. Whether manufacturing medicines, producing fuels, monitoring pollution or developing new materials, chemists rely upon accurate calculations to ensure reactions are efficient, safe and economical. This enquiry introduces students to the mathematical foundations of chemistry, enabling them to quantify chemical change and appreciate how numerical evidence underpins scientific investigation.

Students investigate how atoms and molecules can be counted using the mole, how balanced equations represent chemical reactions and how chemists use calculations to predict the amounts of substances involved in reactions. Through mathematical reasoning, practical investigation and scientific modelling, students develop confidence in applying quantitative methods to real-world chemical problems.



Zoom In

What knowledge, skills and key vocabulary will we learn step by step?

The enquiry begins by introducing the importance of chemical measurements, exploring how chemists measure substances that are far too small to count individually. Students develop the substantive knowledge required to understand relative formula mass, the mole and Avogadro's principle, recognising how these concepts enable chemists to compare and measure chemical substances accurately. Teacher modelling explicitly demonstrates how mathematical calculations are used to represent chemical quantities and solve practical problems.

Students develop disciplinary knowledge by applying mathematical reasoning, interpreting balanced chemical equations and evaluating quantitative evidence. They use calculations to determine the masses of reactants and products, recognising that mathematics provides the language through which chemistry is understood and applied.

Attention then turns to balanced equations, reacting masses and concentration, where students investigate how chemical equations represent conservation of mass and predictable ratios between substances. They apply calculations involving moles, concentration and solution chemistry, developing increasingly sophisticated problem-solving skills through structured mathematical modelling.

As the enquiry progresses, students investigate percentage yield, atom economy and practical efficiency, evaluating why industrial reactions rarely achieve perfect results. They interpret experimental data, identify sources of error and consider how chemists improve manufacturing processes to reduce waste and increase sustainability.

Throughout the enquiry, specialist vocabulary including mole, relative atomic mass, relative formula mass, concentration, balanced equation, reacting mass, atom economy, percentage yield and limiting reactant is explicitly taught and revisited through retrieval practice, worked examples, mathematical modelling and extended scientific explanations.

The enquiry concludes by challenging students to explain how quantitative chemistry enables scientists to predict chemical reactions accurately, improve industrial efficiency and develop more sustainable chemical processes.

	Pre-Requisite Knowledge <i>What have we already learned that will help us with this topic?</i>		Pitch Up <i>How will we challenge ourselves?</i>
	Students build upon their understanding of atomic structure, the Periodic Table and chemical bonding developed in C1 and C2. They apply their knowledge of atoms, molecules and formulae to quantify chemical reactions using mathematical calculations and scientific reasoning.		Students are challenged to move beyond performing routine calculations by explaining what their answers represent in chemical terms. They interpret balanced equations, evaluate industrial processes and apply mathematical reasoning to unfamiliar reaction scenarios. Stretch is embedded through multi-step mole calculations, percentage yield, atom economy and concentration calculations. Students are encouraged to justify their methods, evaluate the efficiency of reactions and explain how quantitative chemistry supports scientific innovation and sustainable manufacturing.
	Wider Framework <i>How does this learning connect to future topics and bigger goals?</i>		Curriculum Hinterland <i>What wider knowledge will deepen our understanding of this topic?</i>

This enquiry forms a key component of the AQA GCSE Chemistry specification and underpins many areas of chemistry, including chemical reactions, industrial chemistry and analytical science. Students develop: • Substantive knowledge of the mole, reacting masses, concentration, percentage yield and atom economy. • Disciplinary knowledge through mathematical application, data analysis, scientific modelling, problem solving and evidence-based reasoning. Students strengthen mathematical fluency by applying formulae, manipulating equations and interpreting quantitative data whilst developing confidence in communicating scientific calculations accurately.	Students explore the work of Amedeo Avogadro, whose ideas transformed our understanding of chemical quantities, alongside the development of modern industrial chemistry and large-scale manufacturing. The enquiry also investigates contemporary applications including pharmaceutical production, food manufacturing, environmental monitoring and sustainable chemical engineering, demonstrating how accurate quantitative chemistry supports modern society.
 Authentic connections <i>How does this topic connect to real life, careers, other subjects and important values?</i>	
The study of Quantitative Chemistry enables students to appreciate how mathematics allows chemists to predict and control chemical change with remarkable precision. Students develop spiritual understanding by recognising the order, consistency and predictability of chemical reactions, appreciating how mathematical patterns underpin the behaviour of matter throughout the natural world. Social and cultural understanding develops through exploring how quantitative chemistry supports the manufacture of medicines, clean drinking water, food production and essential consumer products. Moral understanding is strengthened by evaluating how efficient chemical processes reduce waste, conserve natural resources and contribute towards a more sustainable future. This enquiry has particularly strong links with Mathematics, where students apply ratio, proportion, algebra, percentages and multi-step calculations to solve scientific problems. It reinforces mathematical fluency through data handling, formula manipulation and quantitative reasoning. Links to Design and Technology are developed through consideration of manufacturing efficiency and quality control, whilst English supports students in explaining mathematical methods and communicating scientific conclusions with clarity and precision. This enquiry explicitly develops the following Skills Builder Universal Framework competencies: • Problem Solving – Students apply mathematical reasoning to increasingly complex chemical calculations and unfamiliar scenarios. • Leadership – Students explain methods, support collaborative problem solving and guide peers through multi-step calculations.	

- Listening – Students interpret teacher modelling and scientific explanations to refine mathematical techniques and improve accuracy.

This enquiry provides authentic insight into careers including:

- Process Chemist – Designing efficient manufacturing processes within the chemical industry.
- Pharmaceutical Scientist – Calculating precise quantities to manufacture safe and effective medicines.
- Quality Assurance Analyst – Using quantitative techniques to ensure products meet rigorous scientific standards.



Students recognise that mathematical reasoning, analytical thinking and evidence-based decision making developed throughout this enquiry are highly transferable across science, engineering, finance and many wider professional careers.

 Resources <i>What books, websites, videos and materials will support our learning?</i>	 Assessment <i>How will we show what we know, remember and can apply?</i>
Teaching and learning throughout this enquiry are supported through a range of practical, mathematical and digital resources that develop scientific understanding through modelling, calculation and application. • Teacher modelling, live worked examples and visualisers to explicitly teach quantitative calculations and problem-solving strategies. • Practical investigations measuring reacting masses, concentrations and chemical yields. • Retrieval activities, dual-coded calculation guides and subject-specific vocabulary displays. • Structured calculation practice, exam-style questions and industrial case studies. • AQA GCSE Chemistry specification guidance. • Digital resources including: ○ Cognito ○ Kerboodle ○ BBC Bitesize GCSE Chemistry ○ Oak National Academy ○ Royal Society of Chemistry	Students complete retrieval activities assessing prior understanding of formulae, atomic structure and balanced equations. Diagnostic questioning identifies misconceptions about chemical formulae and mathematical calculations before new learning begins. Students complete structured mole, reacting mass and concentration calculations, interpreting balanced equations and explaining the significance of their mathematical answers within chemical contexts. Students complete a cumulative assessment requiring them to apply quantitative methods to unfamiliar chemical reactions, interpret experimental data, evaluate industrial efficiency and justify conclusions using mathematical reasoning. XX% Substantive Knowledge Students demonstrate knowledge and understanding of: • Relative atomic mass and relative formula mass. • The mole and Avogadro's principle. • Balanced chemical equations. • Reacting mass calculations. • Concentration of solutions. • Percentage yield and atom economy. • Limiting reactants and industrial efficiency.

XX% Disciplinary Knowledge

Students demonstrate their ability to:

- Apply mathematical calculations to chemical reactions.
- Interpret balanced equations and quantitative data.
- Analyse experimental results and identify patterns.
- Evaluate the efficiency of chemical processes using evidence.
- Solve unfamiliar quantitative chemistry problems using logical reasoning.
- Communicate scientific calculations and conclusions using accurate subject-specific vocabulary.

Topic 5

Topic



P4 - Atomic Structure



Big Picture

What are the main ideas and big questions in this topic?

Everything in the universe, from the air we breathe to the stars we observe, is made from atoms. Understanding atomic structure has transformed humanity's view of the universe and driven some of the greatest scientific and technological advances in history. The development of atomic models demonstrates how scientific ideas evolve over time as new evidence becomes available, highlighting the importance of experimentation, collaboration and critical evaluation within science. This enquiry introduces students to the structure of the atom, the history of atomic theory and the behaviour of radioactive materials. Students investigate how radioactive decay can be both hazardous and beneficial, exploring its applications in medicine, industry, archaeology and electricity generation. By understanding the structure of matter at its smallest scale, students develop the scientific foundation required for further study of nuclear physics, chemistry and modern technologies.



Zoom In

What knowledge, skills and key vocabulary will we learn step by step?

The enquiry begins by introducing students to the structure of the atom, exploring the roles of protons, neutrons and electrons, and understanding how atomic number, mass number and isotopes distinguish one atom from another. Students develop the substantive knowledge needed to explain why atoms are electrically neutral, how ions form and why isotopes of the same element behave similarly whilst possessing different nuclear properties.

Teacher modelling explicitly demonstrates how atomic diagrams and nuclear notation are used to communicate scientific ideas accurately. Students develop disciplinary knowledge by interpreting models, analysing experimental evidence and recognising that scientific understanding changes as new discoveries are made.

Attention then turns to the historical development of atomic theory. Students evaluate how the models proposed by Dalton, Thomson, Rutherford, Geiger, Marsden and Bohr evolved through increasingly sophisticated experimentation. By analysing the evidence supporting each model, students appreciate that scientific knowledge is continually refined through observation, experimentation and peer review.

As the enquiry progresses, students investigate radioactive decay, nuclear radiation and half-life. They compare the properties of alpha, beta and gamma radiation, evaluate their penetrating abilities and explore both the risks and benefits of ionising radiation. Practical demonstrations, graphical interpretation and mathematical analysis enable students to identify patterns in radioactive decay whilst applying their understanding to real-world situations including nuclear medicine, radiotherapy, carbon dating and nuclear power generation.

Throughout the enquiry, specialist vocabulary including atom, nucleus, isotope, ion, radioactive decay, alpha, beta, gamma, half-life, contamination and irradiation is explicitly taught and revisited through retrieval practice, discussion, modelling and extended scientific writing.

The enquiry concludes by challenging students to evaluate the ethical, environmental and scientific implications of nuclear technologies. By combining historical evidence, practical investigation and scientific reasoning, students develop a secure understanding of one of the most influential ideas in modern science.

	Pre-Requisite Knowledge <i>What have we already learned that will help us with this topic?</i>		Pitch Up <i>How will we challenge ourselves?</i>
	Students build upon prior learning of the particle model and the structure of matter developed during Key Stage 3. They understand that substances are composed of particles and have previously explored simple atomic models, providing the foundation for studying atomic structure, isotopes and radioactivity in greater depth.		Students are challenged to think beyond memorising atomic structures by evaluating how scientific theories develop over time and why evidence is central to scientific progress. They apply increasingly sophisticated scientific reasoning to unfamiliar situations, interpret decay graphs, evaluate evidence surrounding nuclear technologies and communicate balanced scientific arguments. Stretch is provided through mathematical interpretation of half-life calculations, comparison of competing scientific models and evaluation of the benefits and risks associated with radioactive materials in modern society.
	Wider Framework <i>How does this learning connect to future topics and bigger goals?</i>		Curriculum Hinterland <i>What wider knowledge will deepen our understanding of this topic?</i>
	This enquiry forms part of the AQA GCSE Physics specification and establishes the fundamental principles that underpin nuclear physics, chemistry and many modern scientific technologies. Students develop: Substantive knowledge of atomic structure, isotopes, radioactive decay and nuclear radiation.		Students explore the remarkable scientific discoveries of John Dalton, J. J. Thomson, Ernest Rutherford, Hans Geiger, Ernest Marsden, Niels Bohr and Marie Curie, recognising how their work fundamentally changed humanity's understanding of matter.

Disciplinary knowledge through evaluating scientific models, interpreting evidence, analysing graphical data and applying mathematical reasoning to radioactive decay. Students also strengthen scientific literacy by evaluating historical developments in science and communicating evidence-based conclusions.	The enquiry also examines contemporary applications including cancer treatment, PET scanning, food irradiation, smoke detectors, carbon dating, nuclear power and the continuing search for cleaner, safer nuclear technologies.
 Authentic connections <i>How does this topic connect to real life, careers, other subjects and important values?</i>	
The study of Atomic Structure encourages students to appreciate how scientific discoveries can fundamentally change humanity's understanding of the universe. Students develop spiritual understanding by reflecting upon the incredible scale of the atomic world and recognising that everything around us is built from structures far too small to observe directly. Social and cultural understanding develops through exploring how nuclear science has transformed medicine, engineering and energy production across the world. Moral understanding is strengthened by evaluating the ethical considerations surrounding nuclear weapons, radioactive waste and the responsible use of ionising radiation, encouraging students to consider how scientific discoveries can bring both significant benefits and profound responsibilities. This enquiry explicitly develops the following Skills Builder Universal Framework competencies: - Listening – Students interpret scientific explanations and evaluate how evidence has shaped changing models of the atom. - Speaking – Students justify viewpoints when discussing the risks, benefits and ethical implications of nuclear technology. - Leadership – Students take responsibility during collaborative investigations, supporting others whilst evaluating scientific evidence and drawing reasoned conclusions. This enquiry provides authentic insight into careers including: - Medical Physicist – Using radiation safely to diagnose and treat disease. - Nuclear Engineer – Designing systems that generate electricity safely and efficiently. - Radiation Protection Adviser – Ensuring radioactive materials are used safely in healthcare, industry and research. Students recognise that the critical thinking, evidence evaluation and communication skills developed throughout this enquiry are highly transferable across science, healthcare, engineering and many wider professional sectors.	
 Resources <i>What books, websites, videos and materials will support our learning?</i>	 Assessment <i>How will we show what we know, remember and can apply?</i>



Teaching and learning throughout this enquiry are supported through a range of practical, digital and contextual resources that develop scientific understanding through modelling, investigation and evidence-based reasoning.

- Teacher modelling, live demonstrations and visualisers to explicitly teach atomic structure, radioactive decay and half-life calculations.
- Models of atomic structure to demonstrate the development of scientific theories and the arrangement of subatomic particles.
- Practical demonstrations and simulations exploring the properties of alpha, beta and gamma radiation, radioactive decay and half-life.
- Retrieval activities, dual-coded diagrams and subject-specific vocabulary displays.
- Graphical data, historical sources and case studies to support analysis of the development of atomic theory and the applications of nuclear science.
- AQA GCSE Physics specification guidance and required practical resources.
- Digital resources including:
 - Oak National Academy Physics
 - BBC Bitesize GCSE Physics
 - Institute of Physics
 - National STEM Learning Centre
 - AQA GCSE Physics

Students complete retrieval activities assessing prior understanding of the particle model, elements, compounds and simple atomic structure from Key Stage 3. Diagnostic questioning identifies misconceptions surrounding atoms, isotopes and radiation before new learning begins.

Students interpret models of atomic structure and radioactive decay, analyse graphical data and explain the development of atomic theory using evidence from key historical experiments. Students also apply their understanding to half-life calculations and compare the properties of different types of nuclear radiation.

Students complete a cumulative assessment requiring them to explain atomic structure, evaluate the historical development of scientific models, interpret radioactive decay data and apply their understanding to unfamiliar contexts involving nuclear science and its practical applications.

XX% Substantive Knowledge

Students demonstrate knowledge and understanding of:

- Atomic structure and the properties of protons, neutrons and electrons.
- Atomic number, mass number and isotopes.
- The historical development of atomic models.
- Alpha, beta and gamma radiation.
- Radioactive decay and half-life.
- Uses, risks and benefits of ionising radiation.

XX% Disciplinary Knowledge

Students demonstrate their ability to:

- Interpret and evaluate scientific models of the atom.
- Analyse historical and experimental evidence that led to the development of atomic theory.
- Interpret graphical data and complete calculations involving radioactive decay and half-life.
- Construct balanced scientific arguments about the applications of nuclear technologies.
- Communicate scientific explanations using precise subject-specific vocabulary.

- Apply scientific knowledge confidently to unfamiliar contexts and justify conclusions using evidence.

Topic 6

Topic



B4 Bioenergetics



Big Picture

What are the main ideas and big questions in this topic?

In this topic, students explore how plants harness the Sun's energy through photosynthesis to produce glucose, releasing oxygen that has accumulated in the Earth's atmosphere over millions of years. They investigate the factors that affect the rate of photosynthesis and consider how scientific understanding of this process has transformed modern agriculture and food production. Students then investigate aerobic and anaerobic respiration, exploring how organisms release energy from glucose to carry out life processes. They examine how respiration supports movement, growth and metabolism, investigate the effects of exercise on the human body and evaluate the relationship between respiration, photosynthesis and the cycling of matter within ecosystems.



Zoom In

What knowledge, skills and key vocabulary will we learn step by step?

Students begin by investigating photosynthesis, exploring the word and symbol equations before examining why this process is essential for the survival of plants and other organisms. Through practical investigations they test leaves for starch, investigate oxygen production and interpret experimental evidence to explain how light, carbon dioxide and chlorophyll influence photosynthesis.

Students then investigate factors affecting the rate of photosynthesis, carrying out required practical investigations, analysing graphical data and evaluating how greenhouse conditions can be manipulated to maximise plant growth whilst considering economic and environmental factors.

The topic continues with respiration, where students compare aerobic and anaerobic respiration, investigate energy transfer during exercise and explore how organisms release energy for life processes. Practical investigations enable students to analyse changes in heart rate, breathing rate and breathing volume, interpret physiological data and explain oxygen debt and muscle fatigue.

Finally, students investigate metabolism, exploring how glucose is used to synthesise larger biological molecules and understanding the importance of metabolic reactions in maintaining healthy organisms.

Core Knowledge (Substantive)

Students develop secure knowledge and understanding of:

- photosynthesis and its importance
- factors affecting the rate of photosynthesis
- limiting factors and greenhouse production
- uses of glucose in plants

- aerobic respiration
- anaerobic respiration and fermentation
- the effects of exercise on the body
- oxygen debt
- metabolism and metabolic reactions.

Working Scientifically (Disciplinary)

Students develop their ability to:

- carry out required practical investigations safely
- investigate photosynthesis using starch and oxygen tests
- design and conduct investigations into exercise and respiration
- collect, present and interpret quantitative data
- calculate rates from numerical data and graphs
- evaluate experimental methods and scientific evidence
- apply biological knowledge to unfamiliar contexts.

Key Vocabulary: photosynthesis, chlorophyll, glucose, oxygen, carbon dioxide, limiting factor, starch, destarch, aerobic respiration, anaerobic respiration, fermentation, mitochondria, metabolism, oxygen debt, lactic acid, exercise, respiration, greenhouse, nitrate ions, enzyme

 Pre-Requisite Knowledge <i>What have we already learned that will help us with this topic?</i>	 Pitch Up <i>How will we challenge ourselves?</i>
Students should already understand that plants carry out photosynthesis and that living organisms require energy to survive. They should understand cell structure from B1, the organisation of plants and animals from B2 and be familiar with chemical equations and graph interpretation from previous Biology and Chemistry learning. This prior knowledge provides the foundation for understanding how energy is transferred and used within living organisms.	Pupils are expected to attend science lessons on time, well equipped, ready to take risks and be active learners. To stretch pupils' knowledge of bioenergetics, teachers deepen understanding by connecting abstract concepts to real-world applications and encouraging analytical thinking. Starting with layered questioning—such as “Why is respiration exothermic?” or “How do limiting factors affect photosynthesis efficiency?” - supporting pupils to move beyond memorization and into reasoning. Teachers can introduce case studies like mitochondrial disorders, red blood cell concentration or athletic performance to show how energy transfer impacts health and function. Hands-on experiments, such as measuring heart rate changes during exercise or investigating photosynthesis rates under different conditions, allow pupils to explore energy transfer practically.

	Wider Framework <i>How does this learning connect to future topics and bigger goals?</i>		Curriculum Hinterland <i>What wider knowledge will deepen our understanding of this topic?</i>
	Understanding bioenergetics provides the foundation for many subsequent GCSE Biology topics, including homeostasis and response, ecology and the cycling of materials within ecosystems. Students build upon their understanding of cells, enzymes and biological organisation to explain how energy is transferred and utilised by living organisms. Throughout the topic, students continue to develop the analytical, mathematical and practical skills required for GCSE examinations and further scientific study. The practical investigations undertaken throughout this topic strengthen students' ability to interpret scientific evidence, analyse quantitative data, evaluate experimental methods and communicate scientific conclusions using accurate biological terminology.		Historical context: ○ The discovery of photosynthesis by Jan Ingenhousz and Joseph Priestley. ○ How understanding respiration evolved through studies of metabolism and cellular biology. Scientific connections: ○ The interdependence of photosynthesis and respiration in ecosystems. ○ The role of chloroplasts and mitochondria as energy converters in cells. ○ How these processes maintain atmospheric balance of oxygen and carbon dioxide. Practical applications: ○ Investigating starch in leaves as evidence of photosynthesis. ○ Using yeast to demonstrate anaerobic respiration and fermentation. ○ Exploring how exercise affects respiration rate and muscle fatigue. Misconceptions addressed: ○ Light is not a chemical reactant in photosynthesis. ○ Photosynthesis is not a single reaction but a series of complex steps. Cross-curricular links: ○ Geography: impact of deforestation on oxygen production. ○ PE: respiration and energy release during physical activity. ○ History: how scientific discoveries shaped modern biology
	Authentic connections <i>How does this topic connect to real life, careers, other subjects and important values?</i>		
	Understanding bioenergetics enables students to explain how living organisms obtain, transfer and use energy to survive. Knowledge of photosynthesis, respiration and metabolism underpins agriculture, environmental science, healthcare and sports science, helping students appreciate how biological research contributes to food production, improving health and addressing global sustainability challenges. SMSC is developed through curiosity, responsibility and critical thinking as students evaluate evidence relating to food production, environmental sustainability and healthy lifestyles. Students consider how scientific developments support global food security whilst balancing environmental and economic considerations. Cross-curricular links include Chemistry through energy transfer and chemical reactions, Mathematics through graphical analysis, calculations and interpreting rates of change, Physical Education through exercise physiology and respiration, Geography through ecosystems, food production and climate, and Food Technology through crop production, nutrition and sustainable farming. Students explore careers including:		

- Plant Scientist – improving crop production through research into photosynthesis and plant growth.
- Sports Physiologist – investigating respiration, metabolism and exercise performance to improve health and athletic achievement.
- Agricultural Scientist – developing sustainable farming techniques to increase food production whilst protecting the environment.

The topic supports the Skills Builder Universal Framework, particularly:

- Planning through organising practical investigations and selecting appropriate scientific methods.
- Creativity through designing investigations and evaluating methods for improving plant growth and crop production.
- Problem Solving through applying biological knowledge to unfamiliar contexts involving respiration, agriculture and environmental sustainability.



	Resources <i>What books, websites, videos and materials will support our learning?</i>		Assessment <i>How will we show what we know, remember and can apply?</i>
	At New Line Learning Academy, we are committed to equipping our pupils with high-quality resources that extend learning beyond the classroom and empower them to take ownership of their scientific journey. To enrich and consolidate understanding, pupils have access to a range of carefully selected digital platforms and learning tools: • Cognito (https://cognitoedu.org/home) – Offers engaging video tutorials, concise notes, and practice questions tailored to support mastery of scientific concepts across Key Stage 3 and beyond. • BBC Bitesize (https://www.bbc.co.uk/bitesize/levels/z4kw2hv) – Provides accessible explanations, interactive activities, and revision materials, helping pupils consolidate learning and revisit key topics independently. • Sparx Science – www.sparx-learning.com – the platform used for science homework which will be set each week and provide topics from two weeks previously. The expectation is that pupils will have 100% completion and 100% success • Kerboodle (https://www.kerboodle.com/users/login) – Supports the curriculum with digital textbooks, assessments, and interactive resources aligned to national specifications, offering pupils and teachers a wealth of high-quality materials. These resources not only reinforce classroom learning but also foster curiosity, independence, and confidence, ensuring every pupil can thrive and deepen their scientific understanding at their own pace.		Assessment takes place throughout the enquiry through retrieval practice, required practical investigations, questioning, examination-style questions and independent application tasks. Students demonstrate their understanding by explaining photosynthesis and respiration, interpreting graphs and practical data, applying mathematical skills, analysing the effects of limiting factors and communicating scientific ideas using accurate biological terminology. XX% Substantive Knowledge: Students demonstrate secure understanding of photosynthesis, respiration, limiting factors, metabolism, aerobic and anaerobic respiration, exercise and energy transfer in living organisms. XX% Disciplinary Knowledge: Students apply practical and investigative skills by interpreting experimental data, analysing graphs, evaluating practical methods, applying mathematical skills and constructing evidence-based scientific explanations.

Topic 7 Topic	 C4 – Chemical Changes
	Big Picture <i>What are the main ideas and big questions in this topic?</i>
Chemical reactions transform substances into new materials with different properties. From extracting metals from ores and manufacturing medicines to producing fertilisers and generating electricity, chemical changes underpin many of the processes that shape modern life. This enquiry enables students to understand why reactions occur, how substances behave during chemical change and how chemists harness these reactions to improve society. Students investigate acids, alkalis, salts, electrolysis and the reactivity of metals, developing an appreciation of how chemical changes can be predicted, controlled and applied. Through practical investigation, scientific reasoning and mathematical thinking, students develop the knowledge and skills required to explain a wide range of everyday and industrial chemical processes.	
	Zoom In <i>What knowledge, skills and key vocabulary will we learn step by step?</i>
The enquiry begins by exploring the reactivity of metals, investigating why some metals react more readily than others. Students develop the substantive knowledge required to understand the reactivity series and predict the outcomes of displacement reactions. Teacher modelling explicitly demonstrates how observations from practical investigations provide evidence for constructing and refining scientific explanations. Students develop disciplinary knowledge through practical enquiry, collecting observations, identifying patterns and drawing evidence-based conclusions. They compare experimental results with theoretical predictions, evaluating the reliability of evidence gathered during investigations. Attention then turns to acids, alkalis and salts, where students investigate neutralisation reactions and explore how salts are produced using different laboratory techniques. Practical work develops confidence in selecting suitable methods, making careful observations and evaluating experimental procedures whilst reinforcing the importance of laboratory safety. As the enquiry progresses, students investigate electrolysis, exploring how electricity can be used to decompose ionic compounds and extract reactive metals. They explain the movement of ions, predict products formed at electrodes and evaluate the industrial importance of electrolysis in producing essential materials such as aluminium and chlorine. Throughout the enquiry, specialist vocabulary including acid, alkali, neutralisation, salt, electrolysis, electrolyte, electrode, oxidation, reduction, displacement and reactivity series is explicitly taught and revisited through retrieval practice, practical investigation, teacher modelling and extended scientific writing. The enquiry concludes by challenging students to explain a wide range of chemical reactions using particle models, scientific evidence and the principles of reactivity, recognising how understanding chemical change enables chemists to solve real-world problems.	

	Pre-Requisite Knowledge <i>What have we already learned that will help us with this topic?</i>		Pitch Up <i>How will we challenge ourselves?</i>
	Students build upon their understanding of atomic structure, chemical bonding and quantitative chemistry developed in C1, C2 and C3. They apply their knowledge of ions, electrons and balanced equations to explain chemical reactions, predict products and justify observations using scientific evidence.		Students are challenged to move beyond simply describing chemical reactions by explaining why they occur and predicting their outcomes using scientific models. They evaluate practical methods, interpret reaction data and justify conclusions using their understanding of reactivity and ion movement. Stretch is embedded through interpreting ionic equations, explaining redox processes, predicting electrolysis products and evaluating industrial extraction methods. Students are encouraged to appreciate how chemists manipulate reactions to develop more efficient and sustainable manufacturing processes.
	Wider Framework <i>How does this learning connect to future topics and bigger goals?</i>		Curriculum Hinterland <i>What wider knowledge will deepen our understanding of this topic?</i>
	This enquiry forms a central component of the AQA GCSE Chemistry specification and builds directly upon students' understanding of atomic structure, bonding and quantitative chemistry. Students develop: • Substantive knowledge of the reactivity series, acids, alkalis, salts, electrolysis and redox reactions. • Disciplinary knowledge through practical investigation, scientific observation, evidence evaluation, experimental technique and analytical reasoning. Students strengthen mathematical and scientific literacy through interpreting reaction data, analysing experimental evidence and constructing precise scientific explanations.		Students explore the work of scientists including Humphry Davy, whose pioneering work with electrolysis led to the discovery of several elements, alongside Svante Arrhenius, whose work helped shape our understanding of acids and ions. The enquiry also investigates contemporary applications including aluminium production, electroplating, battery technology, water purification and hydrogen fuel technologies, demonstrating how chemical changes continue to support technological innovation and sustainable industry.
	Authentic connections <i>How does this topic connect to real life, careers, other subjects and important values?</i>		
	The study of Chemical Changes enables students to appreciate how understanding reactions allows society to manufacture essential materials, extract valuable resources and develop cleaner technologies. Students develop spiritual understanding by recognising the remarkable transformations that occur when substances interact, appreciating the predictable yet dynamic nature of chemical reactions.		

Social and cultural understanding develops through exploring how chemical processes provide clean water, medicines, metals and materials that improve quality of life across the world. Moral understanding is strengthened by evaluating the environmental impact of mining, metal extraction and industrial chemistry, considering how sustainable technologies can reduce pollution and conserve finite resources.

This enquiry has strong links with Physics, particularly through the study of electricity during electrolysis and energy transfer within chemical reactions. It complements Geography by exploring the extraction of metals, mining and the environmental impact of resource use. Students apply Mathematics when interpreting reaction data and chemical equations, whilst English develops their ability to construct scientific explanations supported by practical evidence and observations.

This enquiry explicitly develops the following Skills Builder Universal Framework competencies:

- Teamwork – Students collaborate effectively during practical investigations, sharing responsibilities and evaluating experimental evidence together.
- Speaking – Students explain observations, justify predictions and communicate scientific reasoning using accurate chemical terminology.
- Problem Solving – Students apply their understanding of reactivity, electrolysis and chemical equations to unfamiliar reaction scenarios.



This enquiry provides authentic insight into careers including:

- Industrial Chemist – Developing large-scale manufacturing processes for essential chemicals and materials.
- Metallurgist – Investigating the extraction, processing and improvement of metals.
- Environmental Chemist – Applying chemical knowledge to pollution control, water treatment and sustainable resource management.

Students recognise that the practical investigation, analytical thinking and evidence-based reasoning developed throughout this enquiry are highly transferable across chemistry, engineering, environmental science and manufacturing industries.

 Resources <i>What books, websites, videos and materials will support our learning?</i>	 Assessment <i>How will we show what we know, remember and can apply?</i>
Teaching and learning throughout this enquiry are supported through a range of practical, digital and contextual resources that develop scientific understanding through investigation, modelling and application. • Teacher modelling, live demonstrations and visualisers to explicitly teach chemical reactions, electrolysis and laboratory techniques. • Practical investigations exploring metal reactivity, neutralisation, salt preparation and electrolysis. • Retrieval activities, dual-coded diagrams and subject-specific vocabulary displays.	Students complete retrieval activities assessing prior understanding of ions, chemical bonding, balanced equations and quantitative chemistry. Diagnostic questioning identifies misconceptions about chemical reactions before new learning begins. Students complete practical investigations into metal reactivity, neutralisation or salt preparation, interpreting observations, analysing evidence and explaining chemical changes using particle models and ionic equations.

- Laboratory equipment for acid-base reactions, electrolysis and displacement experiments.
- Case studies exploring industrial chemistry, metal extraction and sustainable technologies.
- AQA GCSE Chemistry specification guidance.
- Digital resources including:
 - Cognito
 - Kerboodle
 - BBC Bitesize GCSE Chemistry
 - Oak National Academy
 - Royal Society of Chemistry

Students complete a cumulative assessment requiring them to explain chemical reactions, predict products, interpret experimental evidence and evaluate industrial processes involving electrolysis, acids and metal extraction.

XX% Substantive Knowledge

Students demonstrate knowledge and understanding of:

- The reactivity series of metals.
- Displacement reactions.
- Acids, alkalis and neutralisation.
- Salt preparation methods.
- Electrolysis of molten and aqueous ionic compounds.
- Oxidation and reduction (redox) reactions.
- Industrial extraction of metals and related applications.

XX% Disciplinary Knowledge

Students demonstrate their ability to:

- Interpret observations from practical investigations.
- Predict the products of chemical reactions using scientific principles.
- Explain reactions using particle models and ionic equations.
- Analyse experimental evidence and evaluate the reliability of conclusions.
- Apply scientific understanding to unfamiliar chemical scenarios.
- Communicate explanations using accurate chemical vocabulary and justified scientific reasoning.

Topic 8

Topic



C5 – Energy Changes



Big Picture

What are the main ideas and big questions in this topic?

Every chemical reaction involves energy. Whether fuels are burned to provide warmth, batteries power electrical devices or cold packs reduce swelling after injury, energy changes accompany every chemical process. Understanding how energy is transferred during reactions allows chemists to design more efficient industrial processes, develop cleaner energy technologies and improve the sustainability of modern society.

This enquiry introduces students to the transfer of energy during chemical reactions, exploring why some reactions release energy whilst others absorb it. Through practical investigation, scientific modelling and mathematical reasoning, students develop an understanding of how bond breaking and bond formation determine energy changes and how chemists apply this knowledge to solve real-world challenges.

	Zoom In <i>What knowledge, skills and key vocabulary will we learn step by step?</i>
The enquiry begins by exploring the concept of energy transfer during chemical reactions, distinguishing between exothermic and endothermic processes. Students develop the substantive knowledge required to explain how energy is transferred between reacting substances and their surroundings. Teacher modelling explicitly demonstrates how energy profile diagrams and particle models can be used to explain changes that cannot be observed directly. Students develop disciplinary knowledge through practical investigations measuring temperature changes during reactions. They learn to collect reliable data, identify patterns and evaluate the accuracy of experimental methods, recognising the importance of controlling variables and reducing sources of error. Attention then turns to bond energies, where students investigate how breaking chemical bonds requires energy whilst forming new bonds releases energy. Students use scientific models and mathematical reasoning to explain why reactions are exothermic or endothermic, linking microscopic particle interactions with observable temperature changes. As the enquiry progresses, students investigate practical applications including combustion, thermal decomposition, hand warmers, instant cold packs and rechargeable batteries. They evaluate how understanding energy changes enables scientists and engineers to design more efficient fuels, improve battery technologies and develop sustainable energy solutions. Throughout the enquiry, specialist vocabulary including exothermic, endothermic, activation energy, bond energy, energy profile, combustion, thermal decomposition and catalyst is explicitly taught and revisited through retrieval practice, practical investigation, modelling and extended scientific writing. The enquiry concludes by challenging students to explain energy changes using particle theory and bond energies, recognising that understanding chemical energy is fundamental to developing new technologies and addressing global energy challenges.	
	Pre-Requisite Knowledge <i>What have we already learned that will help us with this topic?</i>
Students build upon their understanding of chemical bonding, quantitative chemistry and chemical reactions developed in C2, C3 and C4. They apply their knowledge of chemical reactions to explain how energy is transferred when bonds are broken and formed.	
	Pitch Up <i>How will we challenge ourselves?</i>
Students are challenged to move beyond identifying whether reactions are exothermic or endothermic by explaining why energy changes occur using particle models and bond energies. They interpret energy profile diagrams, evaluate practical investigations and apply scientific reasoning to unfamiliar reaction scenarios. Stretch is embedded through analysing bond energy calculations, evaluating industrial energy efficiency and explaining how catalysts influence reactions	

		without changing the overall energy transfer. Students are encouraged to consider how advances in chemistry are contributing to future energy solutions.	
	Wider Framework <i>How does this learning connect to future topics and bigger goals?</i>		Curriculum Hinterland <i>What wider knowledge will deepen our understanding of this topic?</i>
This enquiry forms a key component of the AQA GCSE Chemistry specification and provides the foundation for understanding reaction rates, industrial chemistry and sustainable energy technologies. Students develop: - Substantive knowledge of exothermic and endothermic reactions, bond energies, activation energy and energy profile diagrams. - Disciplinary knowledge through practical investigation, scientific modelling, mathematical reasoning, data analysis and evaluation of experimental evidence. Students strengthen their understanding of energy transfer whilst developing the ability to communicate scientific explanations using diagrams, calculations and precise chemical vocabulary.		Students explore the work of scientists including Germain Hess, whose research into energy changes established important principles of thermochemistry, alongside developments in modern battery technology and renewable energy storage. The enquiry also investigates contemporary applications including lithium-ion batteries, hydrogen fuel cells, electric vehicles, heat packs, sustainable fuels and renewable energy technologies, demonstrating how chemistry plays a vital role in meeting global energy demands.	
	Authentic connections <i>How does this topic connect to real life, careers, other subjects and important values?</i>		
The study of Energy Changes enables students to appreciate how chemistry provides solutions to some of the world's greatest energy challenges. Students develop spiritual understanding by recognising the continual movement and transformation of energy throughout the natural world, appreciating the interconnected nature of chemical and physical processes. Social and cultural understanding develops through exploring how energy technologies have transformed transport, healthcare and everyday life. Moral understanding is strengthened by evaluating the environmental impact of different energy sources and considering how chemists are developing cleaner fuels, more efficient batteries and sustainable technologies to reduce carbon emissions. This enquiry builds directly upon learning in Physics, particularly the concepts of energy transfer, conservation of energy and thermal processes. Students apply Mathematics when interpreting graphs, analysing practical results and calculating energy changes. Links to Geography are developed through the study of energy resources and sustainability, whilst English supports students in evaluating evidence and communicating scientific explanations using accurate terminology. This enquiry explicitly develops the following Skills Builder Universal Framework competencies: Creativity – Students apply scientific understanding to evaluate emerging energy technologies and propose innovative solutions to global challenges.			

- Problem Solving – Students interpret energy profile diagrams, analyse practical results and explain energy transfers using scientific models.
- Speaking – Students communicate scientific explanations, justify conclusions and evaluate the advantages and limitations of different energy systems.



This enquiry provides authentic insight into careers including:

- Energy Research Scientist – Developing sustainable fuels and advanced battery technologies.
- Chemical Process Engineer – Improving industrial efficiency through energy optimisation.
- Renewable Energy Consultant – Applying scientific knowledge to develop low-carbon energy solutions.

Students recognise that the analytical thinking, practical investigation and evidence-based reasoning developed throughout this enquiry are highly transferable across chemistry, engineering, environmental science and the wider energy sector.

 Resources <i>What books, websites, videos and materials will support our learning?</i>	 Assessment <i>How will we show what we know, remember and can apply?</i>
Teaching and learning throughout this enquiry are supported through a range of practical, digital and contextual resources that develop scientific understanding through investigation, modelling and application. • Teacher modelling, live demonstrations and visualisers to explicitly teach energy transfers and energy profile diagrams. • Practical investigations measuring temperature changes in chemical reactions. • Retrieval activities, dual-coded diagrams and subject-specific vocabulary displays. • Bond energy calculations, reaction profile modelling and industrial case studies. • Demonstrations of combustion, thermal decomposition and energy storage technologies. • AQA GCSE Chemistry specification guidance. • Digital resources including: ○ Cognito ○ Kerboodle ○ BBC Bitesize GCSE Chemistry ○ Oak National Academy	Students complete retrieval activities assessing prior understanding of chemical reactions, bonding and energy transfer. Diagnostic questioning identifies misconceptions about exothermic and endothermic reactions before new learning begins. Students complete a practical investigation measuring temperature changes during chemical reactions. They analyse their results, interpret energy profile diagrams and explain observations using particle models and bond energies. Students complete a cumulative assessment requiring them to explain energy transfers, interpret reaction profiles, evaluate practical evidence and apply their understanding to unfamiliar chemical and industrial contexts. XX% Substantive Knowledge Students demonstrate knowledge and understanding of: • Exothermic and endothermic reactions. • Energy transfer during chemical reactions. • Activation energy. • Bond breaking and bond formation. • Energy profile diagrams. • Practical applications including combustion, thermal decomposition and energy storage technologies.

- Royal Society of Chemistry

XX% Disciplinary Knowledge

Students demonstrate their ability to:

- Interpret energy profile diagrams and scientific models.
- Analyse data collected during practical investigations.
- Explain energy transfers using particle theory and bond energies.
- Evaluate experimental methods and identify sources of error.
- Apply scientific understanding to unfamiliar chemical scenarios.
- Communicate scientific explanations using accurate subject-specific vocabulary and evidence.

Topic 9

Enquiry



C6 – The Rate and Extent of Chemical Change



Big Picture

What are the main ideas and big questions in this topic?

Chemical reactions occur at different speeds and do not always go to completion. Some reactions, such as explosions, happen almost instantaneously, whilst others, including the rusting of iron, may take years. Understanding why reactions occur at different rates and how equilibrium can be controlled allows chemists to manufacture medicines, optimise industrial processes and reduce waste. This enquiry enables students to explore the factors that influence reaction rates and the dynamic nature of reversible reactions.

Students investigate collision theory, catalysts, reversible reactions and dynamic equilibrium, developing an appreciation of how chemists manipulate conditions to maximise efficiency and sustainability. Through practical investigation, mathematical reasoning and scientific modelling, students develop the knowledge and skills required to explain and predict chemical behaviour in both laboratory and industrial settings.



Zoom In

What knowledge, skills and key vocabulary will we learn step by step?

The enquiry begins by exploring the concept of reaction rate, investigating why some reactions proceed more quickly than others. Students develop the substantive knowledge required to understand collision theory, recognising that successful reactions depend upon particles colliding with sufficient energy and in the correct orientation. Teacher modelling explicitly demonstrates how particle models and graphical representations explain reaction rates at a microscopic level.

Students develop disciplinary knowledge through practical investigations measuring reaction rates. They collect quantitative data, identify patterns and evaluate how variables such as temperature, concentration, pressure, surface area and catalysts influence the frequency of successful collisions. Practical work encourages students to control variables carefully, assess reliability and justify conclusions using scientific evidence.

Attention then turns to reversible reactions and dynamic equilibrium, where students investigate reactions that proceed in both directions simultaneously. They explore how equilibrium can be disturbed by changes in temperature, pressure and concentration, applying Le Chatelier's Principle to predict how industrial processes can be optimised for greater efficiency.

As the enquiry progresses, students investigate industrial applications including the Haber Process and Contact Process, evaluating how chemists balance cost, yield, energy use and environmental considerations when manufacturing essential chemicals. Mathematical analysis and graphical interpretation enable students to explain why industrial conditions are chosen and how scientific understanding contributes to sustainable production.

Throughout the enquiry, specialist vocabulary including collision theory, activation energy, catalyst, reaction rate, reversible reaction, equilibrium, dynamic equilibrium, yield, Le Chatelier's Principle and industrial process is explicitly taught and revisited through retrieval practice, practical investigation, modelling and extended scientific writing.

The enquiry concludes by challenging students to explain how reaction conditions influence both the speed and extent of chemical reactions, recognising how chemists apply these principles to solve global industrial and environmental challenges.

	Pre-Requisite Knowledge <i>What have we already learned that will help us with this topic?</i>		Pitch Up <i>How will we challenge ourselves?</i>
	Students build upon their understanding of chemical bonding, energy changes and chemical reactions developed in C2, C4 and C5. They apply their knowledge of energy transfer and particle behaviour to explain reaction rates, equilibrium and industrial chemistry.		Students are challenged to move beyond describing the factors affecting reaction rate by explaining why these factors influence particle behaviour using collision theory and equilibrium models. They evaluate industrial processes, interpret graphical data and justify why particular reaction conditions are selected. Stretch is embedded through interpreting reaction rate graphs, applying Le Chatelier's Principle to unfamiliar scenarios and evaluating the compromises involved in large-scale chemical manufacture. Students are encouraged to appreciate that chemistry often involves balancing competing scientific, economic and environmental priorities.
	Wider Framework <i>How does this learning connect to future topics and bigger goals?</i>		Curriculum Hinterland <i>What wider knowledge will deepen our understanding of this topic?</i>
	This enquiry forms a significant component of the AQA GCSE Chemistry specification and provides the scientific foundation for industrial chemistry and sustainable manufacturing. Students develop: Substantive knowledge of collision theory, reaction rates, catalysts, reversible reactions and dynamic equilibrium.		Students explore the work of Fritz Haber and Carl Bosch, whose development of the Haber Process transformed global food production through the manufacture of fertilisers. Students also investigate how modern chemical engineers continue to improve industrial processes to increase efficiency whilst reducing environmental impact.

- Disciplinary knowledge through practical investigation, data interpretation, scientific modelling, mathematical reasoning and evidence-based evaluation.

Students strengthen mathematical skills through interpreting reaction graphs and analysing experimental data whilst developing scientific literacy through explanation, evaluation and justification.

The enquiry also explores contemporary applications including catalytic converters, pharmaceutical manufacture, hydrogen production, green ammonia technologies and carbon capture, demonstrating how chemistry continues to support sustainable development across the world.



Authentic connections

How does this topic connect to real life, careers, other subjects and important values?

The study of The Rate and Extent of Chemical Change enables students to appreciate how chemists carefully control reactions to improve efficiency, reduce waste and meet global demand for essential products. Students develop spiritual understanding by recognising the delicate balance that exists within chemical systems and appreciating how small changes in conditions can have significant effects on the natural and industrial world.

Social and cultural understanding develops through exploring how industrial chemistry supports food production, healthcare and manufacturing across the globe. Moral understanding is strengthened by evaluating the environmental impact of industrial processes and considering how scientific innovation can reduce energy consumption, minimise waste and contribute to a more sustainable future.

This enquiry has strong links with Mathematics, where students interpret graphs, analyse data and apply proportional reasoning to scientific investigations. It complements Biology through the study of catalysts and enzyme action, helping students recognise common scientific principles across disciplines. Connections with Design and Technology are developed through the optimisation of industrial manufacturing processes, whilst English supports the evaluation and communication of scientific evidence and conclusions.

This enquiry explicitly develops the following Skills Builder Universal Framework competencies:

- Teamwork – Students collaborate during practical investigations, sharing responsibilities and evaluating evidence collectively.
- Leadership – Students organise investigations, oversee data collection and support others in drawing reliable scientific conclusions.
- Listening – Students interpret teacher explanations, practical demonstrations and scientific evidence to refine their understanding of complex chemical systems.



This enquiry provides authentic insight into careers including:

- Chemical Engineer – Designing efficient industrial processes that maximise yield whilst minimising waste.
- Industrial Process Scientist – Optimising manufacturing systems for pharmaceuticals, fertilisers and consumer products.
- Sustainability Consultant – Applying chemical knowledge to reduce industrial emissions and improve environmental performance.

Students recognise that the analytical thinking, practical investigation, mathematical reasoning and decision-making developed throughout this enquiry are highly transferable across chemistry, engineering, manufacturing and environmental science.

	Resources <i>What books, websites, videos and materials will support our learning?</i>		Assessment <i>How will we show what we know, remember and can apply?</i>
	Teaching and learning throughout this enquiry are supported through a range of practical, digital and contextual resources that develop scientific understanding through investigation, modelling and application. • Teacher modelling, live demonstrations and visualisers to explicitly teach collision theory, equilibrium and industrial processes. • Practical investigations exploring reaction rates using temperature, concentration, catalysts and surface area. • Retrieval activities, dual-coded diagrams and subject-specific vocabulary displays. • Graph interpretation activities, industrial case studies and equilibrium modelling. • Simulations demonstrating dynamic equilibrium and reversible reactions. • AQA GCSE Chemistry specification guidance. • Digital resources including: ○ Cognito ○ Kerboodle ○ BBC Bitesize GCSE Chemistry ○ Oak National Academy ○ Royal Society of Chemistry		Students complete retrieval activities assessing prior understanding of chemical reactions, bonding and energy changes. Diagnostic questioning identifies misconceptions about particle behaviour and energy transfer before new learning begins. Students complete a practical investigation exploring factors affecting reaction rate. They analyse quantitative data, interpret graphs and explain changes in reaction rate using collision theory and scientific evidence. Students complete a cumulative assessment requiring them to explain reaction rates, equilibrium and industrial processes, evaluate practical investigations and apply their understanding to unfamiliar scientific and industrial contexts. XX% Substantive Knowledge Students demonstrate knowledge and understanding of: • Collision theory. • Factors affecting reaction rate. • Catalysts and activation energy. • Reversible reactions. • Dynamic equilibrium. • Le Chatelier's Principle. • Industrial processes including the Haber Process and Contact Process. XX% Disciplinary Knowledge Students demonstrate their ability to: • Plan, conduct and evaluate investigations into reaction rates. • Interpret graphical and experimental data. • Apply collision theory to explain chemical behaviour. • Predict changes to equilibrium using scientific reasoning. • Evaluate industrial processes by balancing scientific, economic and environmental considerations. • Communicate scientific explanations using accurate subject-specific vocabulary and justified evidence.
Topic 10 Topic		B7 - Ecology	



Big Picture

What are the main ideas and big questions in this topic?

The Sun is the ultimate source of energy for almost all ecosystems, with energy flowing through food chains whilst materials such as carbon and water are continually recycled. Throughout this topic, students investigate how organisms interact within complex ecosystems, how environmental conditions influence survival and how adaptations enable organisms to thrive in different habitats.

Students explore the cycling of materials, biodiversity and the increasing impact of human activity on ecosystems across the globe. They consider how pollution, climate change, deforestation and habitat loss threaten biodiversity, before evaluating the actions required to conserve ecosystems and ensure the sustainable use of Earth's natural resources.



Zoom In

What knowledge, skills and key vocabulary will we learn step by step?

Students begin by investigating classification and biodiversity, exploring how organisms are grouped using the Linnaean classification system, binomial naming and Carl Woese's three-domain system. They consider how advances in technology have improved scientific classification and strengthened our understanding of evolutionary relationships.

Students then investigate ecosystems, exploring habitats, communities, competition and interdependence before carrying out required practical fieldwork using quadrats and transects to estimate plant populations and evaluate ecological data. They interpret measures including mean, median, mode and range whilst considering the importance of valid sampling techniques.

The topic develops further through the study of adaptations, food chains, food webs and biomass, investigating energy transfer between trophic levels, the cycling of materials through ecosystems and the role of decomposers in maintaining healthy environments. Students explore the carbon and water cycles, rates of decay and the production of biogas through practical investigations.

Finally, students investigate human impacts on the environment, exploring biodiversity, pollution, global warming, deforestation and conservation strategies before evaluating how scientific knowledge can be used to balance human needs with environmental sustainability.

Core Knowledge (Substantive)

Students develop secure knowledge and understanding of:

- classification systems and biodiversity
- ecosystems, habitats and communities
- competition and interdependence
- biotic and abiotic factors
- sampling using quadrats and transects
- adaptations and extremophiles
- food chains, food webs and trophic levels

- biomass and energy transfer
- carbon, water and decay cycles
- decomposition and biogas
- biodiversity and conservation
- pollution, deforestation and climate change
- sustainable management of ecosystems.

Working Scientifically (Disciplinary)

Students develop their ability to:

- carry out ecological fieldwork safely
- use quadrats and transects appropriately
- calculate mean, median, mode, range and rates
- analyse and interpret ecological data
- evaluate sampling techniques and experimental methods
- interpret graphs and environmental data
- communicate scientific explanations using accurate biological terminology.

Key Vocabulary: ecosystem, habitat, community, biodiversity, competition, interdependence, quadrat, transect, random sampling, adaptation, extremophile, producer, consumer, decomposer, trophic level, biomass, carbon cycle, water cycle, decay, biogas, pollution, deforestation, conservation, greenhouse effect, global warming, sustainability

 Pre-Requisite Knowledge <i>What have we already learned that will help us with this topic?</i>	 Pitch Up <i>How will we challenge ourselves?</i>
Students should already understand photosynthesis, respiration, evolution and adaptation from previous Biology topics, together with the movement of substances through ecosystems. They should be familiar with graph interpretation, practical investigations and data analysis. This prior learning provides the foundation for investigating ecosystems, biodiversity and environmental sustainability in greater depth.	Pupils are expected to attend science lessons on time, well equipped, ready to take risks and be active learners. To enrich pupils' understanding of ecology, teachers elevate classroom learning by linking core concepts to global environmental challenges and fostering systems-level thinking. Enquiry-based approaches that use layered questioning such as: "How does the decline of one species ripple across an ecosystem?" or "In what ways do human activities disrupt ecological balance?" are aimed to encourage deeper reasoning and critical exploration. Teachers reference case studies such as coral bleaching, invasive species, or rewilding efforts helps students see how ecological principles play out in real-world contexts.

	Wider Framework <i>How does this learning connect to future topics and bigger goals?</i>		Curriculum Hinterland <i>What wider knowledge will deepen our understanding of this topic?</i>
	Understanding ecology brings together knowledge from across the GCSE Biology curriculum, including photosynthesis, respiration, adaptation, evolution and biological organisation. Students apply this understanding to explain interactions within ecosystems, the cycling of materials and the impact of environmental change on living organisms. Throughout the topic, students continue to develop the analytical, mathematical and practical skills required for GCSE examinations and further scientific study. The fieldwork and investigations undertaken throughout this topic strengthen students' ability to collect and interpret ecological data, evaluate scientific evidence and communicate scientific conclusions using accurate biological terminology.		Historical narratives: • The story of Rachel Carson and <i>Silent Spring</i> - how one book sparked the environmental movement. • The reintroduction of wolves to Yellowstone and its cascading ecological effects. • The Dust Bowl—how poor land management led to ecological disaster. Scientific intrigue: • How keystone species shape entire ecosystems. • The concept of ecological succession and how nature recovers after disturbance. • The role of decomposers in nutrient cycling - nature's recyclers. Real-world relevance: • Case studies of conservation efforts (e.g. coral reef restoration, rewilding projects). • How climate change affects species distribution and migration. • The ethics of human intervention—balancing development and sustainability. Cross-curricular links: • Geography: land use, climate zones, and environmental management. • Citizenship: sustainability, activism, and global responsibility. • History: industrialisation and its ecological consequences.
	Authentic connections <i>How does this topic connect to real life, careers, other subjects and important values?</i>		

Understanding ecology enables students to explain how organisms interact within ecosystems, how energy and materials move through the environment and how human activities influence biodiversity and sustainability. Knowledge of ecology underpins environmental science, conservation, agriculture and climate research, helping students appreciate how biological understanding supports informed decisions about protecting the natural world. SMSC is developed through curiosity, responsibility and stewardship as students evaluate evidence relating to climate change, biodiversity loss and conservation. Students consider the balance between meeting human needs and protecting ecosystems for future generations whilst appreciating the interconnected nature of life on Earth.

Cross-curricular links include Geography through ecosystems, climate change, sustainability and resource management, Mathematics through ecological sampling, statistical analysis and graphical interpretation, Chemistry through nutrient cycles and atmospheric processes, and PSHE through environmental responsibility, sustainable lifestyles and global citizenship.

Students explore careers including:

- Ecologist – investigating ecosystems, biodiversity and the relationships between living organisms.
- Conservation Scientist – protecting habitats and developing strategies to conserve endangered species.
- Environmental Consultant – applying scientific evidence to minimise environmental impacts and support sustainable development.
- Marine Biologist – investigating aquatic ecosystems and protecting marine biodiversity.
- Climate Scientist – analysing environmental data to understand climate change and its impact on ecosystems.

The topic supports the Skills Builder Universal Framework, particularly:

- Planning through organising ecological investigations and selecting appropriate sampling techniques.
- Teamwork through collaborating during fieldwork and environmental investigations.
- Problem Solving through applying ecological knowledge to unfamiliar environmental and conservation contexts.



 Resources <i>What books, websites, videos and materials will support our learning?</i>	 Assessment <i>How will we show what we know, remember and can apply?</i>
At New Line Learning Academy, we are committed to equipping our pupils with high-quality resources that extend learning beyond the classroom and empower them to take ownership of their scientific journey. To enrich and consolidate understanding, pupils have access to a range of carefully selected digital platforms and learning tools: • Cognito (https://cognitoedu.org/home) – Offers engaging video tutorials, concise notes, and practice questions tailored to support mastery of scientific concepts across Key Stage 3 and beyond. • BBC Bitesize (https://www.bbc.co.uk/bitesize/levels/z4kw2hv) – Provides accessible explanations, interactive activities, and revision materials, helping pupils consolidate learning and revisit key topics	Assessment takes place throughout the enquiry through retrieval practice, fieldwork investigations, questioning, examination-style questions and independent application tasks. Students demonstrate their understanding by explaining interactions within ecosystems, interpreting ecological and environmental data, analysing food webs and biodiversity, evaluating conservation strategies and communicating scientific ideas using accurate biological terminology. XX% Substantive Knowledge Students demonstrate secure understanding of ecosystems, biodiversity, food chains and food webs, sampling techniques, adaptations, the cycling of materials, human impacts on the environment and conservation.

independently.

- Sparx Science – www.sparx-learning.com – the platform used for science homework which will be set each week and provide topics from two weeks previously. The expectation is that pupils will have 100% completion and 100% success
- Kerboodle (<https://www.kerboodle.com/users/login>) – Supports the curriculum with digital textbooks, assessments, and interactive resources aligned to national specifications, offering pupils and teachers a wealth of high-quality materials.

These resources not only reinforce classroom learning but also foster curiosity, independence, and confidence, ensuring every pupil can thrive and deepen their scientific understanding at their own pace.

XX% Disciplinary Knowledge

Students apply practical and investigative skills by carrying out ecological fieldwork, interpreting graphs and environmental data, analysing sampling techniques, evaluating scientific evidence and constructing evidence-based scientific explanations.