
SCIENCE DEPARTMENT KEY STAGE 4 COMBINED SCIENCE CURRICULUM OVERVIEW

The Science department key stage 4 Combined Science curriculum is designed to implement the Academy’s vision of “Deepening Learning, Raising Aspiration”, in line with the OAT curriculum strategy of “Teach, Develop, Change”. Our curriculum is carefully designed to build resilience, aspiration and independence in our learners. We carefully design the KS4 curriculum to further develop and build upon prior learning at KS3.

Science in key stage 4 continues with the process of building upon and deepening scientific knowledge and the understanding of ideas developed in earlier key stages in the subject disciplines of biology, chemistry and physics.

For some students, studying the sciences in key stage 4 provides the platform for more advanced studies, establishing the basis for a wide range of careers. For others, it will be their last formal study of subjects that provide the foundations for understanding the natural world and will enhance their lives in an increasingly technological society.

Science is changing our lives and is vital to the world’s future prosperity, and all students should be taught essential aspects of the knowledge, methods, processes and uses of science. They should be helped to appreciate the achievements of science in showing how the complex and diverse phenomena of the natural world can be described in terms of a number of key ideas relating to the sciences which are inter-linked, and which are of universal application.

Diversity

Our Science curriculum covers many of the world’s greatest Scientists including Darwin and Dalton (England), Einstein (Germany), Boyle (Ireland). We introduce a wide range of Scientists during the learning of the three different disciplines in Science, for example in Physics, radioactivity, we learn about Marie Curie (Poland) who discovered radium, Katherine Johnson (African American) whose calculations enabled the USA moon landing. In Biology, we learn about the work of Rosalind E Franklin (England) who, through x-ray crystallography was central to the understanding of the molecular structure of DNA. In Chemistry, we teach about Percy Julian (African American) a renowned research chemist who was a pioneer in the chemical synthesis of medicinal drugs from plants. We discuss innovations with related subjects and this includes Mary Jackson, NASA’s first black female engineer and Ada Lovelace a mathematician and pioneer of computing.

We introduce the students to new and emerging technologies from around the world in the context of their wider learning and celebrate events such as Earth Day and National Technology Day. We encourage our students to discuss and debate views on Science from other religions such as Hinduism and Creationists.

Year
10

Week 1

Week 2

Week 3

Week 4

Week 5

Week 6

Week 7

Week 8

Week 9

Week 10

Week 11

Week 12

Autumn

**Cell Biology
Organisation****Infection and Response**

Diversity

Cell structure
Cell division
Transport in cellsAnimal and plant tissues
Organs and organ systems
Communicable diseases**Bonding, Structures and the Properties of Matter
Quantitative Chemistry and Chemical Changes****Atomic Structure, Periodic Table**

Diversity

Model of the atom
Periodic Table
Chemical bondingChemical measurements
Conservation of mass
Reactivity of metals
Electrolysis

Spring

**Energy
Electricity
Particle Model of Matter**Energy stores and systems
Global energy resources
Electrical quantities
Series and parallel circuitsDomestic uses and safety
The particle model
Internal energy
Particle model and pressure**Bioenergetics
Homeostasis and Response**Photosynthesis
RespirationHuman nervous system
Hormonal coordination in humans
Reproduction

Summer

**Energy Changes
The Rate and Extent of Chemical Change
Organic Chemistry**Exothermic and endothermic reactions
Rate of reaction
Reversible reactions and equilibriumCrude oil, hydrocarbons and alkanes
Fractional distillation
Cracking and alkenes**Atomic Structure
Forces**

Diversity

Atoms and isotopes
Atoms and nuclear radiation
Forces and their interactionsWork done and energy transfer
Forces and elasticity
Forces and motion

Autumn Half Term 1**Block 1 – Weeks 1 to 3****Cell Biology**

- Explore how structural differences between types of cells enable them to perform specific functions.
- Recognise, draw and interpret diagrams that model transport in cells (diffusion, osmosis and active transport)

Block 2 – Weeks 4 to 6**Organisation, Infection and Response**

- Study the digestive, respiratory and circulatory systems
- Learn about damage to these systems, effects on the body and treatments or prevention
- Study how plant tissues are related to their function
- Study prevention of diseases, how the body defends and responds to pathogen

Notes/Links/Interleaving

- **Refers back to and builds on Cells and Infectious Diseases (Year 7), Human Body (Year 8) and Biology Fundamentals 1 and 2 (Year 9) and links to A Level Biology topics.**

Additional Higher Content

- Calculating magnification using equations
- Evaluating ethical issues in the use of stem cells
- Using models and analogies to develop explanations of how cells divide

Autumn Half Term 2**Block 3 – Weeks 7 to 9****Atomic structure and the Periodic Table, Structure, Bonding and Properties of Matter**

- Studying the model of the atom in detail
- Advanced study of the periodic table and its development
- Studying theories of structure and bonding to explain physical and chemical properties of materials

Block 4 – Weeks 10 to 12**Quantitative Chemistry and Chemical Changes**

- Using quantitative analysis to determine formulae of compounds and equations for reactions
- Calculating relative formula mass and chemical measurements
- Studying the reactivity of metals and acids
- Explaining electrolysis

Notes/Links/Interleaving

- **Refers back to Particles and Compounds (Year 7) and Chemistry Fundamentals 1 and 2 (Year 9) and links to A Level Chemistry topics**

Additional Higher Content

- Writing half and ionic equations
- Using moles to balance equations
- Explain the effect of limiting a reactant

Spring Half Term 1**Block 1 – Weeks 1 to 3****Energy and Electricity**

- Describe changes in the way energy is stored and changes within a system
- Studying the conservation and dissipation of energy
- Evaluating energy resources
- Describing and calculating charge flow, current, resistance and potential difference in both series and parallel circuits

Block 2 – Weeks 4 to 6**Electricity Continued and Particle Model of Matter**

- Studying the domestic uses, safety and energy transfer of mains electricity
- Predict the behaviour of solids liquids and gases using the particle model
- Calculate temperature changes in a system, specific heat capacity and latent heat
- Using particle model to explain pressure

Notes/Links/Interleaving

- **Refers back to Energy and Particles (Year 7), Electricity and Magnetism (Year 8), Physics Fundamentals 1 and 2 (Year 9) and links to A Level Physics topics**

Additional Higher Content

- Describing how to increase efficiency of a system
- Rearranging equations to make other quantities the subject

Spring Half Term 2**Block 3 – Weeks 7 to 9****Bioenergetics**

- Explore how plants harness the sun's energy to make food through photosynthesis
- Identifying the uses of glucose by a plant
- Describe cellular respiration both aerobic and anaerobic to transfer energy
- Explain the importance of sugars, amino acids, fatty acids and glycerol in the synthesis and breakdown of nutrients

Block 4 - Weeks 10 to 12**Homeostasis and Response**

- Explore the structure and function of the nervous system and how this brings about fast responses
- Understanding the role of hormones and their slower changes in the body
- Explaining how reproductive hormones have allowed scientists to develop contraception and fertility drugs

Notes/Links/Interleaving

- **Refers back to Cells and Genes and Reproduction (Year 7), Human Body and Ecology and Plants (Year 8), Biology Fundamentals 1 (Year 9) and links to A Level Biology**

Additional Higher Content

- Explain the role of hormones in modern reproductive technologies to treat infertility
- Explain negative feedback with thyroxine and adrenalin

Summer Half Term 1

Block 1 – Weeks 1 to 3

Energy Changes, Rate and Extent of Chemical Change

- Distinguish between endothermic and exothermic reactions and evaluate the applications
- Draw, use and explain reaction profiles (energy level diagrams)
- Studying rate of reactions, factors affecting rates and reversible reactions

Block 2 – Weeks 4 to 6

Organic Chemistry

- Recognise substances as alkanes given their formulae (methane, ethane, propane, butane)
- Explain how fractional distillation works
- Studying cracking and alkenes

Notes/Links/Interleaving

- **Refers back to Particles (Year 7), Chemical Reactions (Year 8) and Chemistry Fundamentals 1 (Year 9) and links to A Level Chemistry**

Additional Higher Content

- Calculate the energy transferred in chemical reactions using bond energies
- Calculate gradient of a tangent to the curve on graphs
- Describe the effect of changing conditions, concentration, temperature and pressure on equilibrium

Summer Half Term 2

Block 3 – Weeks 7 to 9

Atomic Structure

- Describing atoms and isotopes
- Describing the properties of alpha particles, beta particles and gamma rays
- Explain the concept of half-life for radioactive decay
- Understand the difference between irradiation and contamination

Block 4 – Weeks 10 to 12

Forces

- Describing forces and their interactions
- Calculating work done and energy transferred
- Investigating elasticity and using the relevant equations
- Studying forces and motion, stopping distance and factors which affect it

Notes/Links/Interleaving

- **Refers back to Energy, Particles and Forces (Year 7), Chemistry Fundamentals 1, Physics Fundamentals 2 and links to A Level Physics**

Additional Higher Content

- Calculating the reduction in nuclei in radioactive decay
- Adding and resolving forces and use vector diagrams
- Calculating the distance travelled/displacement by an object from the area under a velocity–time graph
- Explain circular motion and inertial mass in general terms
- Studying and calculating momentum

Year
11

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Autumn	Inheritance, Variation and Evolution						Chemical Analysis					
	Ecology						Chemistry of the Atmosphere					
	Diversity						Using Resources					
	Reproduction Variation and evolution Understanding genetics Classification of organisms			Adaptations Ecosystems Biodiversity and the effects of humans on ecosystems			Purity and formulations Identification of gases Earth's atmosphere Greenhouse gases			Atmospheric pollutants Using earth's resources Potable water Life cycle assessments		
Spring	Waves						Revision					
	Magnetism and Electromagnetism											
	Waves in air, fluids & solids Properties and applications of electromagnetic waves			Permanent and induced magnetism Magnetic forces and fields Electromagnetism and the motor effect			All topics Exam skills and practice					
Summer	Revision and Exams						Revision and Exams					
	All topics Exam skills and practice						Biology paper 1 and paper 2 Chemistry paper 1 and paper 2 Physics paper 1 and paper 2					

Autumn Half Term 1**Block 1 – Weeks 1 to 3****Inheritance, Variation and Evolution**

- Studying sexual and asexual reproduction, meiosis and mitosis
- Describe the structure of DNA and predict the results of a gene cross
- Describe variation in a population and explain the theory of evolution
- Describe selective breeding and genetic engineering of food crops and animals
- Understand the Linnaean system of classification

Block 2 – Weeks 4 to 6**Ecology**

- Study of adaptations, interdependence and competition
- Describe the levels of organisation in an ecosystem
- Studying biodiversity and the effect of human interaction on ecosystems
- Understand the abundance of organisms, feeding relationships, mean, mode and median
- Explain the role of microorganisms in cycling materials through an ecosystem

Notes/Links/Interleaving

- **Refers back to Genes and Reproduction (Year 7), Ecology and Plants (Year 8) and links to A Level Biology**

Additional Higher Content

- Construct a genetic cross by punnet square to make predictions using the theory of probability
- Describe the main steps in the process of genetic engineering

Autumn Half Term 2**Block 3 – Weeks 7 to 9****Chemical Analysis and Chemistry of the Atmosphere**

- Studying pure substances, formulations and chromatography
- Describe the processes and results of tests to identify common gases
- Describing the composition and evolution of the Earth's atmosphere
- Studying greenhouse gases and the effect of human activities can contribute
- Common atmospheric pollutants their sources

Block 4 – Weeks 10 -12**Using Resources**

- Describe atmospheric pollutants from fuels, their properties and effects
- Distinguish between potable and pure water and steps in water treatment
- Carry out simple comparative life cycle assessments
- Evaluate ways of reducing the use of limited resources

Notes/Links/Interleaving

- **Refers back to Compounds (Year 7), Chemical Reactions and Chemistry of the Earth (Year 8) and links to A Level Chemistry**

Additional Higher Content

- Evaluate alternative biological methods of metal extraction given appropriate information

Spring Half Term 1**Block 1 – Weeks 1 to 3****Waves**

- Describe the difference between longitudinal and transverse waves
- Studying properties of waves and wave speed
- Study of the electromagnetic spectrum and the transfer of energy
- Describe the properties and applications of electromagnetic waves

Block 2 – Weeks 4 to 6**Magnetism and Electromagnetism**

- Explain the difference between permanent and induced magnets
- Describe and draw magnetic forces and fields
- Describe electromagnetism
- Explain how a solenoid can increase magnetic field

Notes/Links/Interleaving

- **Refers back to Waves and the Solar System, Electricity and Magnetism (Year 8), Physics Fundamentals 1 (Year 9), Electricity and links to A Level Physics**

Additional Higher Content

- Explaining why each type of electromagnetic wave is suitable for its practical application
- Using wave front diagrams to explain refraction
- Describing transmission and detection of radio waves
- Using Flemings LHR and explaining how electric motors work

Spring Half Term 2**Block 3 – Weeks 7 to 9****Paper 1 Revision**

- Biology topics
- Chemistry topics
- Physics topics
- Exam skills and practice

Block 4 – Weeks 10 to 12**Paper 1 and Paper 2 Revision**

- Biology topics
- Chemistry topics
- Physics topics
- Exam skills and practice

Notes/Links/Interleaving

- **Revision of the whole course**

Additional Higher Content

- Higher level content as taught throughout the course

Summer Half Term 1**Block 1 – Weeks 1 to 3****Paper 2 Revision**

- Biology topics
- Chemistry topics
- Physics topics
- Exam skills and practice

Block 2 – Weeks 4 to 6**Revision and Exams**

- Biology paper 1 and paper 2
- Chemistry paper 1 and paper 2
- Physics paper 1 and paper 2

Notes/Links/Interleaving

- **Revision of the whole course**

Additional Higher Content

- Higher level content as taught throughout the course

Summer Half Term 2**Block 3 – Weeks 7 to 9****Revision and Exams**

- Biology paper 1 and paper 2
- Chemistry paper 1 and paper 2
- Physics paper 1 and paper 2

Block 4 – Weeks 10 to 12**Revision and Exams**

- Biology paper 1 and paper 2
- Chemistry paper 1 and paper 2
- Physics paper 1 and paper 2

Notes/Links/Interleaving

- **Revision of the whole course**

Additional Higher Content

- Higher level content as taught throughout the course