SCIENCE KEY STAGE 3

Units taught in Year 7

Biology	Chemistry	Physics
Cells	Mixtures	Energy
Reproduction	Acids and Alkalis	Current Electricity
Muscles and Bones	The Particle Model	Forces
Ecosystems	Atoms, Elements and Molecules	Sound

Units taught in Year 8

Biology	Chemistry	Physics
Food and Nutrition	Combustion	Fluids
Plants and their Reproduction	Periodic Table	Light
Breathing and Respiration	Metals	Energy Transfers
Unicellular Organisms	Rocks	Earth and Space

The primary focus of science teaching at Key Stage 3 is to build upon and broaden the understanding of biology, chemistry and physics developed during Key Stage 2.

Schemes of work are designed to assist learning through a mixture of theory and practical investigation. Pupils are encouraged to work scientifically by collecting and recording data from investigations and evaluating their results.

During Key Stage 3 pupils will become more aware of some of the big ideas in science. Examples of these big ideas include:

- links between the structure and function in living organisms
- the particle model and how this is used to describe the interactions of matter
- the use of energy resources and the ways in which energy is transferred.

Pupils are encouraged to relate scientific explanations to things that they see around them. Some abstract concepts require the use of models. Pupils will use these models to explain scientific phenomena and will learn how to evaluate the usefulness of these models.

SCIENCE KEY STAGE 3

Subject Content Includes

Biology

Cells: observing cells using a light microscope, comparing plant and animal cells and learning the functions of sub- cellular structures

Skeletal and muscular systems: the structure and function of the human skeleton, the interaction between skeleton and muscles and the function of muscles.

Reproduction: reproduction in humans, including the structure and function of the male female reproductive systems, and reproduction in plants, including flower structure and fertilisation.

Chemistry

Atoms, elements and compounds: models of the atom, differences between atoms elements and compounds and an introduction to chemical symbols and formulae.

Chemical reactions: combustion of fuel and its effects on the environment and the reactions of acid and alkalis.

The periodic table: how Mendeleev developed his periodic table, models of the atom and trends within the periodic table.

Physics

Motion and forces: the relationship between speed, distance and time, constructing force diagrams, investigating Hooke's law and understanding non-contact forces.

Current electricity: constructing circuits, taking current and voltage measurements and understanding the difference between series and parallel circuits.

Earth and space: why we have seasons, our son is a star and beyond the solar system

SCIENCE – KEY STAGE 4

GCSE study in the sciences provides the foundation for understanding the material world. Scientific understanding is changing our lives and is vital to the world's future prosperity.

All students should learn essential aspects of the knowledge, methods, processes and uses of science. They should gain appreciation of how the complex and diverse phenomena of the natural world can be described in terms of a small number of key ideas that relate to the sciences and that are both inter-linked and of universal application.

These key ideas include:

- the use of conceptual models and theories to make sense of the observed diversity of natural phenomena
- the assumption that every effect has one or more cause • that change is driven by differences between different objects and systems when they interact
- that many such interactions occur over a distance and over time without direct contact
- that science progresses through a cycle of hypothesis, practical experimentation, observation, theory development and review
- that quantitative analysis is a central element both of many theories and of scientific methods of inquiry.

These key ideas are relevant in different ways and with different emphases in the three subjects as part of combined science. Examples of their relevance are given for each subject in the separate sections below for Biology, Chemistry and Physics components of combined The GCSE in Combined Science should enable students to:

- develop scientific knowledge and conceptual understanding through the specific disciplines of Biology, Chemistry and Physics
- develop understanding of the nature, processes and methods of science, through different types of scientific enquiries that help them to answer scientific questions about the world around them
- develop and learn to apply observational, practical, modelling, enquiry and problem-solving skills in the laboratory, in the field and in other learning environments
- develop their ability to evaluate claims based on science through critical analysis of the methodology, evidence and conclusions, both qualitatively and quantitatively.

Students should study the sciences in ways that help them to develop curiosity about the natural world, that give them an insight into how science works and that enable them to appreciate its relevance to their everyday lives. The scope and nature of the study should be broad, coherent, practical and satisfying. It should encourage students to be inspired, motivated and challenged by the subject and its achievements.

SCIENCE – KEY STAGE 4

The key ideas studied in biology include:

- life processes depend on molecules whose structure is related to their function
- the fundamental units of living organisms are cells, which may be part of highly adapted structures including tissues, organs and organ systems, enabling living processes to be performed effectively
- living organisms may form populations of single species, communities of many species and ecosystems, interacting with each other, with the environment and with humans in many different ways
- living organisms are interdependent and show adaptations to their environment
- life on Earth is dependent on photosynthesis in which green plants and algae trap light from the Sun to fix carbon dioxide and combine it with hydrogen from water to make organic compounds and oxygen
- organic compounds are used as fuels in cellular respiration to allow the other chemical reactions necessary for life
- chemicals in ecosystems are continually cycling through the natural world
- the characteristics of a living organism are influenced by its genome and its interaction with the environment
- evolution is a process of natural selection and accounts for biodiversity and how organisms are all related to varying degrees.

Whilst studying biology, students will also complete a series of required practicals. The methods used and the concepts learned in these practicals will be tested in the final exams.

Biology Core practicals:

- Investigate biological specimens using microscopes, including magnification calculations and labelled scientific drawings from observations
- Investigate the effect of pH on enzyme activity
- Investigate osmosis in potatoes
- Investigate the effect of light intensity on the rate of photosynthesis Investigate the rate of respiration in living organisms
- Investigate the relationship between organisms and their environment using field-work techniques, including quadrats and belt transects

SCIENCE – KEY STAGE 4

The key ideas studied in chemistry are:

- matter is composed of tiny particles called atoms and there are about 100 different naturally occurring types of atoms called elements
- elements show periodic relationships in their chemical and physical properties
- these periodic properties can be explained in terms of the atomic structure of the elements
- atoms bond by either transferring electrons from one atom to another or by sharing electrons
- the shapes of molecules (groups of atoms bonded together) and the way giant structures are arranged is of great importance in terms of the way they behave
- there are barriers to reaction so reactions occur at different rates
- chemical reactions take place in only three different ways: proton transfer, electron transfer, electron sharing
- energy is conserved in chemical reactions so can therefore be neither created nor destroyed.

Whilst studying chemistry, students will also complete a series of required practicals. The methods used and the concepts learned in these practicals will be tested in the final exams.

Chemistry core practicals

- Investigate the composition of inks using simple distillation and paper chromatography
- Investigate the change in pH on adding powdered calcium hydroxide/calcium oxide to a fixed volume of dilute hydrochloric acid
- Investigate the preparation of pure, dry hydrated copper sulfate crystals starting from copper oxide including the use of a water bath
- Investigate the electrolysis of copper sulfate solution with inert electrodes and copper electrodes
- Investigate the effects of changing the conditions of a reaction on the rates of chemical reactions by:
  a) measuring the production of a gas (in the reaction between hydrochloric acid and marble chips)
  b) observing a colour change (in the reaction between sodium thiosulfate and hydrochloric acid)

SCIENCE – KEY STAGE 4 PHYSICS

The key ideas studied in physics are:

- the use of models, as in the particle model of matter or the wave models of light and of sound
- the concept of cause and effect in explaining such links as those between force and acceleration, or between changes in atomic nuclei and radioactive emissions
- the phenomena of 'action at a distance' and the related concept of the field as the key to analysing electrical, magnetic and gravitational effects
- that differences, for example between pressures or temperatures or electrical potentials, are the drivers of change
- that proportionality, for example between weight and mass of an object or between force and extension in a spring, is an important aspect of many models in science
- that physical laws and models are expressed in mathematical form.

Whilst studying physics, students will also complete a series of required practicals. The methods used and the concepts learned in these practicals will be tested in the final exams.

Physics core practicals

- Investigate the relationship between force, mass and acceleration by varying the masses added to trolleys
- Investigate the suitability of equipment to measure the speed, frequency and wavelength of a wave in a solid and a fluid
- Investigate refraction in rectangular glass blocks in terms of the interaction of electromagnetic waves with matter
- Construct electrical circuits to: a investigate the relationship between potential difference, current and resistance for a resistor and a filament lamp b test series and parallel circuits using resistors and filament lamps
- Investigate the densities of solid and liquids
- Investigate the properties of water by determining the specific heat capacity of water and obtaining a temperature-time graph for melting ice
- Investigate the extension and work done when applying forces to a spring

SCIENCE – KEY STAGE 4

Mathematical skills

Throughout the examinations students will be tested on the use of maths skills in relation to science.

The mathematical skills and use of mathematics statements listed will be assessed through the content of this qualification in the examinations. The minimum level of mathematics in the foundation tier examination papers will be equivalent to Key Stage 3 mathematics. The minimum level of mathematics in the higher tier examination papers will be equivalent to foundation tier GCSE in Mathematics.

Students will be expected to

- Recognise and use expressions in decimal form
- recognise and use expressions in standard form
- use ratios, fractions and percentages
- make estimates of the results of simple calculations
- use an appropriate number of significant figures
- find arithmetic means
- construct and interpret frequency tables and diagrams, bar charts and histograms
- principles of sampling as applied to scientific data
- understand simple probability
- understand the terms mean, mode and median
- use a scatter diagram to identify a correlation between two variables
- make order of magnitude calculations
- understand and use mathematical symbols
- change the subject of an equation
- substitute numerical values into algebraic equations using appropriate units for physical quantities
- solve simple algebraic equations
- translate information between graphical and numerical
- understand that y = mx + c represents a linear relationship
- plot two variables from experimental or the data
- determine the slope and intercept of a linear graph
- draw and use the slope of a tangent to a curve as a measure of rate of change
- understand the physical significance of area between a curve and the X axis and measure it by counting squares as appropriate
- use angular measures in degrees
- visualise and represent 2-D and 3-D forms, including two-dimensional representations of 3-D objects
- calculate areas of triangles and rectangles, surface areas and volumes of cubes

SCIENCE – KEY STAGE 4

During the study of science the following skills are also developed:

Cognitive skills

- Non-routine problem solving – expert thinking, metacognition, creativity.
- Systems thinking – decision making and reasoning.
- Critical thinking – definitions of critical thinking are broad and usually involve general cognitive skills such as analysing, synthesising and reasoning skills.
- ICT literacy – access, manage, integrate, evaluate, construct and communicate.

Interpersonal skills

- Communication – active listening, oral communication, written communication, assertive communication and non-verbal communication.
- Relationship-building skills – teamwork, trust, intercultural sensitivity, service orientation, self-presentation, social influence, conflict resolution and negotiation.
- Collaborative problem solving – establishing and maintaining shared understanding, taking appropriate action, establishing and maintaining team organisation.

Intrapersonal skills

- Adaptability – ability and willingness to cope with the uncertain, handling work stress, adapting to different personalities, communication styles and cultures, and physical adaptability to various indoor and outdoor work environments.
- Self-management and self-development – ability to work remotely in virtual teams, work autonomously, be self-motivating and self-monitoring, willing and able to acquire new information and skills related to work.