Science

Course overview

The science faculty aims to allow pupils to develop a deep scientific knowledge and conceptual understanding across the three disciplines and provide opportunities for different types of scientific enquiry that help them to answer scientific questions about the world around them. This scientific knowledge will allow pupils to be able to describe the uses and implications of science. Pupils will become resilient and reflective independent learners who enjoy working collaboratively and creatively in unfamiliar and challenging situations.

Key Stage 3 Curriculum

Across KS3, Science is taught using a detailed scheme of work based around Pearson's 'Exploring Science' scheme. The course not only allows pupils to develop a deep and secure scientific knowledge, but also progressively develops pupils' ability to "work scientifically". Literacy and numeracy are fully integrated into its core teaching strategy in preparation for the new GCSE specifications. All pupils have the opportunity to access interactive, online resources to support homework tasks, revision and independent study.

During each year in KS3, pupils study 4 Biology, 4 Chemistry and 4 Physics topics, with pupils studying a mix of Science topics each term. Each topic contains 7-8 hours teaching time. For summative assessment, pupils complete a short test at the end of each topic as well as three level-assessed Working Scientifically Investigations each year and three "assess yourself" tasks, one of each for the three sciences.

In Year 7, pupils are taught science for 6 periods a fortnight and all classes are mixed ability. In Year 8 students are again taught in mixed ability groups for 6 periods a fortnight. In year 9, the most able scientists are placed in 4 groups, with the remainder of pupils taught in mixed ability sets.

Year 7

Biology

7A - Cells, tissues, organs and systems: this unit starts by reminding students about the features of organisms, and then looks at organs, tissues and cells.
7B - Sexual reproduction in animals: this unit explores sexual reproduction in animals including the human reproductive system and sexual reproduction in humans.
*7C – Muscles and bones: t*his unit uses a 'fitness' theme to cover three important organ systems: the gas exchange system, the circulatory system and the loco motor system.
*7D – Ecosystems: w*ith a general theme about explorers, this unit looks at ecosystems and the factors that affect them. This includes the impact of human activity and the importance of biodiversity.

Chemistry

7E – Mixtures and separation: this unit focuses on mixtures, solutions and separation techniques using the context of providing clean drinking water.
7F – Acids and alkalis: this unit looks at acids and alkalis and how they are described using a pH number.
7G – The particle model: this unit develops an understanding of the different properties of solids, liquids and gases within the context of waste management and disposal.
7H – Atoms, elements and compound: this unit expands on particle theory and explains the differences between atoms, and molecules, elements and compounds.

Physics

7I – Energy: this unit introduces the idea that stores of energy are needed to make most things happen. It looks at food, energy stores and transfers, and energy resources.
7J – Current electricity: this unit looks at the measurement of current and how it behaves in series and parallel circuits, and at voltage and resistance.
7K – Forces: this unit revises the concepts of forces and their effects and extends students' knowledge of friction, gravity and springs.

7L – Sound: this unit looks at how sounds are made, transmitted and detected, some uses of sound and compares sound waves with waves on the surface of water.

Year 8

Biology
8A – Food and nutrition: this unit looks at the main components in the human diet and why they are needed. The digestive system is also covered in some detail, and the idea of enzymes is introduced.
8B – Plants and their reproduction: this unit covers sexual and asexual reproduction in plants. Classification and biodiversity are also covered.
8C – Breathing and respiration: this unit covers gas exchange in humans and other organisms, together with details of aerobic and anaerobic respiration in humans.
8D – Unicellular organisms: this unit takes a detailed look at what unicellular organisms are, the differences between different types, their problems and their uses.

Chemistry
8E – Combustion: this unit uses the context of combustion engines to cover combustion and oxidation reactions, including those of hydrocarbons, metals and non-metals.
8F – The periodic table: this unit uses the context of fireworks to develop students' understanding of matter, atoms and chemical and physical change.
8G – Metals and their uses: this unit uses the context of metals used in building to review common physical properties of metals, and to introduce their main chemical properties.
8H – Rocks: this unit examines the different types of rock and the processes that bring about their formation, leading to the idea of a rock cycle that operates within a huge geological timescale.

Physics
8I – Fluids: this unit looks at changes of state, and then goes on to look at fluids and some of their effects, including pressure, floating and sinking, and drag.
8J – Light: this unit revises work from KS2 on light, which is then extended to consider how light travels and what happens when it meets an object.
8K – Energy transfers: this unit looks at energy transfers by heating in the context of homes.
8L – Earth and Space: this unit builds on work from KS2 on the Solar System and looks at the Earth, including the seasons and the Earth's magnetic field and gravity.

Year 9

Biology
9A – Genetics and evolution: this unit covers a recap of variation and then looks at inherited variation. DNA is introduced before students consider how inherited genes can affect an organism's survival.
9B – Plant growth: this unit looks at photosynthesis and aerobic respiration in plants in more detail, and then considers plant adaptations.

Chemistry
9E – Making materials: this unit looks at the manufacture, properties and uses of different types of materials. The first three topics introduce examples of ceramic, polymer and composite materials.
9F – Reactivity: this unit looks at physical changes and gas pressure, then the reactivity series and a chemical method of preventing rusting is covered. Exothermic and endothermic reactions are introduced.

Physics
9I – Forces and motion: this unit starts by revising some aspects of forces and their effects, energy stores and transfers. It then looks at calculations of speed and relative speed.
9J – Force fields and electromagnets: this unit starts by revising previous work on magnetic and gravitational fields, and then introduces static electricity and the idea of an electric field. Work on current electricity is also revised.

Progression through the science curriculum

The science faculty have adopted a slightly difference system of Steps to the rest of the curriculum. The fundamentals are the same, though because of the topic based nature of the curriculum we have year specific objectives for each step. These have been produced broadly based on the following principles:

Step 1: pupils recall knowledge and understanding of scientific principles.

Step 2: pupils describe scientific principles and phenomena

Step 3: pupils describe some processes and phenomena drawing on abstract ideas and using appropriate scientific terminology

Step 4: pupils describe some processes and phenomena drawing on abstract ideas and using appropriate terminology. They are able to take account of a number of factors or use abstract ideas or models in their explanations of processes and phenomena

Step 5: pupils describe a wide range of processes and phenomena, using abstract ideas and appropriate terminology and sequencing a number of points. Pupils demonstrate extensive knowledge and understanding. They are able to explain, using abstract ideas where appropriate, the importance of some applications and implications of science.

Science – Biology Steps (Year 7)

Step	Competency
1	▪ I can remember the 7 basic life processes and use these to identify if something is living or non-living. I can also state that cells are the "building blocks" of organisms and can name simple organs and their functions ▪ I can name and describe the functions of some tissues and organs in the human reproductive systems ▪ I can remember the role of the circulatory and skeletal system ▪ I can identify ways in which an animal is suited to its environment [for example, a fish having fins to help it swim
2	▪ I can describe a tissue, an organ and an organ system and describe how multicellular organisms are organised ▪ I can explain how gametes are involved in fertilisation and how the fertilised egg develops in the womb ▪ I can identify and describe the functions of parts of the skeletal and muscular systems ▪ I can describe how organisms are interdependent, for example using food chains to describe feeding relationships between plants and animals in a habitat
3	▪ I can describe the structure of cells, and the function of their organelles. I can also describe the structure of a tissue, an organ and an organ system and describe how multicellular organisms are organised ▪ I can describe the stages of pregnancy and birth. I can also describe the stages of the menstrual cycle ▪ I can recall the structure and functions of the human skeleton, and the interaction between the skeleton and muscles. I can also measure the force exerted by different muscles and the function of muscles ▪ I can explain why almost all life on Earth depends on photosynthetic organisms. I can explain that organisms are found in different habitats because of differences in environmental factors. I can link adaptations of organisms to their habitat

Science – Biology Steps (Year 8)

Step	Competency
2	▪ I can list the contents of a healthy human diet and describe why each part is needed ▪ I can describe the process of fertilisation in a plant and explain different ways that the seeds are dispersed ▪ I can describe the mechanism of breathing to move air in and out of the lungs. I can also name and describe the two types of respiration, and I can list the reactants and products of these ▪ I can identify the structural adaptations of some unicellular organisms
3	▪ I can describe the components of a healthy human diet (carbohydrates, lipids (fats and oils), proteins, vitamins, minerals, dietary fibre and water), and explain why they are needed. I can relate the consequences of an imbalance in the diet to specific health issues (obesity, starvation and deficiency diseases) ▪ I can describe the different processes involved in plant reproduction (including flower structure, wind and insect pollination, fertilisation, seed and fruit formation and dispersal). I can also understand that both evidence and creative thinking contribute to make scientific ideas, such as the classification of living things ▪ I can explain how structures in the human gas exchange system are adapted to their functions ▪ I can identify structural adaptations of microorganisms and describe uses microorganisms in different situations
4	▪ I can explain the reason for the different components of a healthy human diet and am able to calculate the energy requirements of a healthy human diet. I can link adaptations of different parts of the digestive system to their functions ▪ I can understand that both evidence and creative thinking contribute to make scientific ideas, such as the classification of living things. I can also apply and use knowledge and understanding in new situations, such as identifying the method of seed dispersal in different plants. ▪ I am able to recall the word equation for aerobic respiration and anaerobic respiration in humans and microorganisms, including the idea of formation and the effect of lactic acid build up. ▪ I am able to link a number of factors and abstract ideas or models in my explanation of the recycling of carbon

Science – Biology Steps (Year 9)

Step	Competency
3	▪ I can describe, in detail, the role of DNA, genes and chromosomes in heredity ▪ I can describe that variation between species and between individuals of the same species means some organisms compete more successfully. I can also explain that this variation between individuals within a species can be continuous or discontinuous ▪ I can list the reactants and products of photosynthesis and summarise these in a word equation. I can explain how plants make carbohydrates in their leaves and gain mineral nutrients and water from the soil ▪ I can explain how some structural adaptations of plants' leaves aid photosynthesis
4	▪ I can describe some evidence for the causes of variation between living things. I can link variation to the role of DNA, genes and chromosomes in heredity ▪ I know the differences between species and that changes in the environment may leave individuals within a species, and some entire species, less well adapted. I understand that these will compete less successfully and fail to reproduce, which in turn may lead to extinction ▪ I can explain how plants are adapted for photosynthesis (including the word equation) and an understanding of gas exchange through the stomata and transpiration (including the route of water movement through the plant) ▪ I can make suggestions to improve the yield of crops grown by farmers and link these to potential environmental problems
5	▪ I can understand a simple model of chromosomes, genes and DNA in heredity, including the part played by Watson, Crick, Wilkins and Franklin in the development of the DNA model ▪ I can use knowledge about Intra and interspecies variation to explain how this can drive natural selection. I can describe the stages in natural selection and how this can lead to extinction ▪ I can explain how plants are adapted for photosynthesis (including the word equation) and an understanding of gas exchange through the stomata and transpiration (including the route of water movement through the plant). I can link adaptations a plant may have with the habitat it is found in ▪ I can make suggestions to improve the yield of crops grown by farmers and link these to potential environmental problems. I can link environmental problems caused by pesticides and fertilisers with their impact on other organisms

Science – Chemistry Steps (Year 7)

Step	Competency
1	▪ I can explain that some substances are pure and that some are impure and has a basic knowledge of separating mixtures ▪ I can state that different acids and alkalis may have different strengths ▪ I can name and describe the properties of the three states of matter ▪ I have a basic understanding of the periodic table and know that it contains groups of elements
2	▪ I can identify simple techniques for separating mixtures and select appropriate techniques for separating given mixtures ▪ I can state the purpose of an indicator and describe how Universal indicator is used to find the strength of an acid or alkali using the pH scale ▪ I can name and describe the properties of the three states of matter and can explain the states in terms of particles ▪ I can represent elements using chemical symbols
3	▪ I can describe how to carry out simple techniques for separating mixtures ▪ I can describe neutralisation and provide examples of neutralisation in everyday life ▪ I can explain the properties of the three states of matter with reference to the particle model ▪ I can represent chemical reactions using word equations

Science – Chemistry Steps (Year 8)

Step	Competency
2	▪ I can describe combustion and oxidation as examples of chemical reactions ▪ I have some understanding of the periodic table and know that groups of elements have similar properties ▪ I can list the properties of metals and non-metals and I can describe how these properties make them suitable for different uses ▪ I can describe the structure and processes within the earth and am able to describe how the earth's resources are used
3	▪ I can describe combustion and oxidation with word equations and I can also state that metal and non-metal oxides react differently with water and I can describe these differences ▪ I have an understanding of chemical properties, atomic structure and patterns in the periodic table and can link these to the properties of elements ▪ I can describe the properties of metals and also I can explain how metals react with water using word equations ▪ I have knowledge of the current theories for the structure, composition and processes within the earth and am able to describe sustainable use of the earth's resources
4	▪ I can describe combustion and oxidation with word equations and I can also state that metal and non-metal oxides react differently with water and I can describe these differences. I can describe the impact of the combustion of fuels on the atmosphere ▪ I can link knowledge of chemical properties and atomic structure to patterns in the periodic table and use these to explain the properties of elements ▪ I can represent various chemical reactions using formulae and symbol equations including the reactions between metals and water and metals and acid ▪ I have a detailed knowledge of the current theories for the structure, composition and processes within the earth and am able to link these with sustainable use of the earth's resources

Science – Chemistry Steps (Year 9)

Step	Competency
3	▪ I am able to name some polymers and describe their properties and uses ▪ I am able to identify some environmental impacts from the manufacture of different materials ▪ I am able to understand some chemical reactions and can describe the products formed, the energy changes and observations. I can state that energy may be released or absorbed during chemical reactions, and I can describe how the temperature of the surroundings changes during a chemical reaction ▪ I can describe simple displacement reactions when given the order of metals and carbon in the reactivity series
4	▪ I am able to name some polymers and describe their properties and uses. I can describe the structure of polymers using models ▪ I am able to identify some environmental impacts from the manufacture of different materials and provide some suggestions to minimise the environmental impact ▪ I am able to understand some chemical reactions and can describe the products formed, the energy changes and observations. I can state that energy may be released or absorbed during chemical reactions, and I can describe how the temperature of the surroundings changes during a chemical reaction. I can represent various chemical reactions using formulae and symbol equations ▪ I can predict the outcomes of simple displacement reactions when given the order of metals and carbon in the reactivity series
5	▪ I am able to name some polymers and describe their properties and uses. I can describe the structure of polymers using models and describe their formation ▪ I am able to identify some environmental impacts from the manufacture of different materials and provide some suggestions to minimise the environmental impact. I can analyse the effectiveness of recycling ▪ I am able to understand some chemical reactions and can describe the products formed, the energy changes and observations. I can state that energy may be released or absorbed during chemical reactions, and I can describe how the temperature of the surroundings changes during a chemical reaction. I can represent chemical reactions using balanced symbol equations ▪ I can discuss and suggest methods that may be used to extract metals more reactive than carbon

Science – Physics Steps (Year 7)

Step	Competency
1	▪ I can name the energy type that is stored in food and fuel and can compare energy values of different foods in kJ (using food labels) ▪ I can use simple scientific ideas and evidence I have collected to explain my observations, for example using a switch to turn off a light bulb in an electrical circuit ▪ I know that a force is a push or a pull and is measured in Newtons. I can also show forces using arrows, which show both the direction and size of the force ▪ I can make general statements such as sounds getting fainter the further the listener is from the source
2	▪ I can name the energy type that is stored in food and fuel and can compare energy values of different foods in kJ (using food labels) and I can describe several situations where energy is transferred ▪ I can use simple scientific ideas and evidence I have collected to explain my observations, for example using a switch to turn off a light bulb in an electrical circuit. I am able to construct both series and parallel circuits ▪ I know that a force is a push or a pull and is measured in Newtons. I can also show the direction and size of a force using arrows. I can describe the effect of changing pressure on an object. I can also calculate pressure using a given equation ▪ I can make general statements such as sounds getting fainter the further the listener is from the source. I can state that sound is produced by vibrations and name some devices that detect sound
3	▪ I can name the energy type that is stored in food and fuel and can compare energy values of different foods in kJ (using food labels), I can describe situations where energy is transferred and how the energy in different energy resources can be used ▪ I can use simple scientific ideas and evidence I have collected to explain my observations, for example using a switch to turn off a light bulb in an electrical circuit. I am able to construct both series and parallel circuits ▪ I know that a force is a push or a pull and is measured in Newtons. I can also the direction and size of the force using arrows. I can describe the effect of changing pressure on an object, ways of increasing and decreasing pressure. I can calculate pressure and explain the effects of pressure in terms of particles ▪ I can make general statements such as sounds getting fainter the further the listener is from the source. I can state that sound is produced by vibrations and name devices that detect sound. I can describe what frequency is and measured in

Science – Physics Steps (Year 8)

Step	Competency
2	▪ I can describe similarities and differences between particles in solids, liquids and gases, particularly in terms of their motion and how close they are to each other ▪ I can state that during specular reflection in a plane mirror, the angle of incidence is always equal to the angle of reflection ▪ I can state that thermal energy is transferred by conduction in solids, convection in liquids and radiation in vacuums and transparent objects. I can state that thermal energy is transferred from hotter objects to colder objects ▪ I can state that gravity is a non-contact force that affects objects within a gravitational field. I can state that all objects have a gravitational field, that this varies in strength and that the gravitational field strength of Earth is 10 N
3	▪ I am able to describe similarities and differences between particles in solids, liquids and gases, particularly in terms of their motion and how close they are to each other. I can calculate density when given the mass and volume of an object ▪ I can state that during specular reflection in a plane mirror, the angle of incidence is always equal to the angle of reflection. I can describe refraction using a ray model diagram ▪ I can describe and explain how thermal energy is transferred by conduction, convection and radiation ▪ I can describe how the gravitational field strength of an object changes due to the size (mass) of the object
4	▪ I am able to describe similarities and differences between particles in solids, liquids and gases, particularly in terms of their motion and proximity to each other. I can calculate density when given the mass and volume of an object I can use calculations of density to predict whether an object will float or sink ▪ I can state that during specular reflection in a plane mirror, the angle of incidence is always equal to the angle of reflection. I can describe refraction using a ray model diagram. I can describe how white light is a mixture of colours with reference to frequency, and I can explain how a prism may be used to diffuse the different colours of light, with reference to refraction and wave speed. ▪ I can describe and explain how thermal energy is transferred by conduction, convection and radiation. I can calculate energy efficiency ▪ I can calculate weight when given mass and gravitational field strength

Science – Physics Steps (Year 9)

Step	Competency
3	▪ I can calculate the average speed of an object ▪ I can explain how levers work to multiply force ▪ I can define the term 'direct current' ▪ I can list some uses of electromagnets
4	▪ I can calculate the average speed of an object ▪ I can explain how levers work to multiply force ▪ I can define the term 'direct current' ▪ I can list some uses of electromagnets
5	▪ I can interpret resultant forces to predict the effect on an object's motion ▪ I can explain how levers work to multiply force I can calculate moments and resultant moments ▪ I can calculate resistance when given potential difference and current ▪ I can suggest some applications for materials of higher or lower resistance ▪ I can describe how to make an electromagnet and increase the strength of an electromagnet and I can describe how to make a simple motor using electromagnetism and a bar magnet

Science – Working Scientifically Steps (all years)

Step	Competency
1	▪ I can identify risks in an experiment ▪ I can make observations and measure quantities, such as length or mass, and choose a range of simple equipment ▪ I can carry out a fair test with some help, and explain what makes it fair ▪ I can give an explanation for my observations and for the patterns in measurements I have made and recorded ▪ I am beginning to communicate in a scientific way what I have found out and suggest improvements in my work
2	▪ I can use a fair test to answer a question, and select suitable equipment and information from that provided ▪ I can follow instructions, and take action to control risks to myself ▪ I can make a series of observations and measurements and vary one factor while keeping others the same ▪ I can record my observations using tables and bar charts and begin to plot points to form simple graphs ▪ I can relate my conclusions to patterns in data, including graphs, and to scientific knowledge ▪ I can communicate my conclusions using appropriate scientific language and suggest improvements in my work, giving reasons
3	▪ I can decide on a suitable approach to a task, including choosing the source of information, apparatus and method ▪ I can recognise hazard symbols and make, simple suggestions to control obvious risks to myself and others ▪ I can draw line graphs to present data, interpret numerical data and make conclusions from them ▪ I can make a scientific conclusion that is consistent with the evidence I have collected ▪ I can communicate my conclusions using scientific language and mathematical terms ▪ I can evaluate my methods to make sensible suggestions for improvements to my experiments and investigations, giving detailed reasons
4	▪ I can identify a sensible approach in investigatory work, by choosing and using sources of information, and scientific knowledge. The methods I have chosen collect adequate data for the task. I can measure precisely, using instruments with fine scale divisions. I understand that I should repeat my measurements ▪ I can recognise a range of familiar risks and take action to control them ▪ I choose which type table, diagram or graph and the scale needed to record my results ▪ I can analyse my results to draw conclusions that are consistent with the evidence I have collected. I can use scientific knowledge to explain them and also begin to explain any inconsistencies in my evidence. I am able to perform calculations with numerical data to make comparisons and draw conclusions ▪ I can communicate descriptive (qualitative) and numerical (quantitative) results, using scientific conventions and terminology ▪ I can evaluate my evidence, making thoughtful suggestions about how my methods could be improved

5	▪ I can plan appropriate approaches and procedures, by using information from a range of sources and identifying key factors in complicated situation. I can plan approaches when variables cannot easily be controlled. I select and use methods to obtain reliable data, including making repeating observations and measurements. I use a range of apparatus precisely ▪ I recognise the need for a risk assessment and use appropriate sources of information. I am able to change my methods if necessary ▪ I record data in graphs, using lines of best fit. I can identify anomalies ▪ I can analyse findings to draw conclusions that are consistent with the evidence and use scientific knowledge to explain these conclusions and identify possible limitations in primary and secondary data ▪ I can use numerical (quantitative) relationships between variables. I can perform multistep calculations such as speed. I communicate effectively, using a wide range of scientific terminology, including symbols ▪ I can consider whether the data I have collected are sufficient for the conclusions I have drawn