SCIENCE

KEY TOPIC/VALUE	AUTUMN 1	AUTUMN 2	SPRING 1	SPRING 2	SUMMER 1	SUMMER 2
YEAR 7	**Scientific apparatus** Learn the different types of apparatus used in science and how to work safely in the lab.	**Scale and Models** Develop the concept of scale and evaluate the benefits of scientific models	**Planning Investigations** Identify key variables used in an investigation. Develop concept of fair testing and working safely	**Maths Skills in Science** Use formula in scientific equations. Calculate means and display data accurately in graphs	**Making Observations and using evidence** Carry out accurate observations in practical work and combine these with scientific theory to evaluate results	**Plan and carry out detailed investigations** Consolidate learning by designing valid experiments, collecting reliable data and fully analysing results
	These topics are taught during the Autumn Term rotation: C1 Pure or Impure introduces one of the key scientific models used in science, namely the Particle Model. Students learn how to classify materials based on their physical properties and relate this to the arrangement of the particles at the sub-microscopic level. They then apply these ideas to explain the features of solutions and other mixtures. B1 Cells and Genetics introduces the key building blocks of all living things. Students study the parts (organelles) found in plant and animal cells and look at how specialized cells are arranged in multicellular organisms such as humans, with a key focus on the skeletal system.		These topics are taught during the Spring Term rotation: B2 Reproduction and Genetics covers the early stages of new life, from fertilisation to birth. Human reproduction is compared with other animals to understand why some organisms produce so many offspring but with low survival rates. Reproduction in plants looks at pollination and fertilization in flowering plants. Students are also introduced to inheritance of characteristics through genetics and the biological changes that happen during puberty. P1 Forces predict motion looks at contact and non-contact forces, studying the effects of friction as well as the forces involved in floating and sinking. The unit also introduces speed and velocity, and how balanced and resultant forces affect moving objects.		These topics are taught during the Summer Term rotation: P2 Fields produce Forces looks at the difference between mass and weight and the effect of gravity in our Solar System. It then goes on to consider magnetic fields and how to produce electromagnets. C2 The Properties of Materials introduces the Periodic Table and students learn to classify elements as metals and non-metals based on their properties. They then consider the properties of acids and alkalis and look at uses of neutralization.	

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YEAR 8	**Patterns in data** Construct appropriate graphs linked to the type of variable used. Identify patterns or trends in data	**Ethics in Science** Consider ethical issues in science and make informed judgements on scientific ideas	**Units of Measurement** Recognise the correct units for measurements and convert small and large units correctly. Introduce significant figures and standard form.	**Repeatable and reproducible** Plan investigations to produce repeatable and reproducible results	**Making a hypothesis** Create an idea for an investigation based on observations. Use different sampling techniques to test a hypothesis	**Analyse and evaluate data** Construct accurate graphs to fully present data. Make measurements from graphs to fully evaluate results
	These topics are taught during the Autumn Term rotation: C3 Reactions involves understanding the differences between physical and chemical changes. Students then study a range of different types of chemical reaction, including combustion and thermal decomposition and displacements. B3 Being Healthy considers what constitutes a healthy diet as well as the implications of a poor diet. Students then study the processes involved in the digestive and respiratory systems and the ways the systems are adapted for these processes.		These topics are taught during the Spring Term rotation: C4 The Rock Cycle looks at the composition of the Earth and the different rock types found on its surface (crust). Students consider the processes that form these rocks and how different conditions affect the properties of the rocks produced. The second part of the unit looks at the composition of the atmosphere and the processes that have changed it in the past as well as those that are continuing to change it today. P3 Energy considers one of the fundamental themes of physics and introduces students to the idea of energy stores and transfers. They then focus on thermal (heat) energy and study the various ways in which it can be transferred through different materials and processes. Students then explore light and sound, considering their properties and how they travel.		These topics are taught during the Summer Term rotation: Students learn to explain and predict the effects of changing components and their arrangements in electrical circuits. The second part of the unit considers how electricity is generated at power stations and the options for both renewable and non-renewable resources as energy sources. B4 Classification and Photosynthesis develops understanding of keys and how to classify organisms in a systematic way. Relationships between organisms in a habitat are considered, along with ways to represent them and sampling techniques. Students then study photosynthesis, as this is the key process at the start of all food chains.	

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YEAR 9	**Using appropriate apparatus and models** Select apparatus that is appropriate for an investigation. Create and evaluate scientific models using correct scaling. (Biology Cells; Chemistry Mixtures)	**Developing Maths skills in Science** Construct simple equations. Create and use formula triangles to rearrange equations. Use correct units for measurements. (Physics Energy)	**Evaluating Evidence** Consider the development of scientific ideas and the evidence used to make new theories. (Chemistry Periodic Table)	**Displaying and analysing results** Choose correct sampling techniques to produce graphical data. Take measurements from graphs to identify trends in data (Biology Organisation; Physics Forces and interactions)	**Accuracy and Precision** Select apparatus and techniques to make data precise and accurate. (Chemistry Metals; Physics Motion)	**Controlling variables** Identify variables that can affect an investigation and plan relevant controls. Recognise anomalies in data and how these are caused and can be resolved. (Biology Infection and Response)

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Cells: Cells are the basic unit of all forms of life. In this section we explore how structural differences between types of cells enables them to perform specific functions within the organism. These differences in cells are controlled by genes in the nucleus. For an organism to grow, cells must divide by mitosis producing two new identical cells. If cells are isolated at an early stage of growth before they have become too specialised, they can retain their ability to grow into a range of different types of cells. This phenomenon has led to the development of stem cell technology. This is a new branch of medicine that allows doctors to repair damaged organs by growing new tissue from stem cells. **Mixtures, chemical analysis and purity:** Analysts have developed a range of qualitative tests to detect specific chemicals. The tests are based on reactions that produce a gas with distinctive properties, or a colour change or an insoluble solid that appears as a precipitate. Instrumental methods provide fast, sensitive and accurate means of analysing chemicals, and are particularly useful when the amount of chemical being analysed is small. Forensic scientists and drug control scientists rely on such instrumental methods in their work. **Organisation:** In this section we will learn about the human digestive system which provides the body with nutrients and the respiratory system that provides it with oxygen and removes carbon dioxide. In each case they provide dissolved materials that need to be moved quickly around the body in the blood by the circulatory system. Damage to any of these systems can be debilitating if not fatal. Although there has been huge progress in surgical techniques, especially with regard to coronary heart disease, many interventions would not be necessary if individuals reduced their risks through improved diet and lifestyle. We will also learn how the plant's transport system is dependent on environmental conditions to ensure that leaf cells are provided with the water and carbon dioxide that they need for photosynthesis.		**Forces and interactions:** Engineers analyse forces when designing a great variety of machines and instruments, from road bridges and fairground rides to atomic force microscopes. Anything mechanical can be analysed in this way. Recent developments in artificial limbs use the analysis of forces to make movement possible. **Atoms and the Periodic Table:** The periodic table provides chemists with a structured organisation of the known chemical elements from which they can make sense of their physical and chemical properties. The historical development of the periodic table and models of atomic structure provide good examples of how scientific ideas and explanations develop over time as new evidence emerges. The arrangement of elements in the modern periodic table can be explained in terms of atomic structure which provides evidence for the model of a nuclear atom with electrons in energy levels. **Energy and heat transfer:** The concept of energy emerged in the 19th century. The idea was used to explain the work output of steam engines and then generalised to understand other heat engines. It also became a key tool for understanding chemical reactions and biological systems. Limits to the use of fossil fuels and global warming are critical problems for this century. Physicists and engineers are working hard to identify ways to reduce our energy usage.		**Ionic Bonding:** Chemists use theories of structure and bonding to explain the physical and chemical properties of materials. Analysis of structures shows that atoms can be arranged in a variety of ways, some of which are molecular while others are giant structures. Theories of bonding explain how atoms are held together in these structures. Scientists use this knowledge of structure and bonding to engineer new materials with desirable properties. The properties of these materials may offer new applications in a range of different technologies. **Infection and response:** Pathogens are microorganisms such as viruses and bacteria that cause infectious diseases in animals and plants. They depend on their host to provide the conditions and nutrients that they need to grow and reproduce. They frequently produce toxins that damage tissues and make us feel ill. This section will explore how we can avoid diseases by reducing contact with them, as well as how the body uses barriers against pathogens. Once inside the body our immune system is triggered which is usually strong enough to destroy the pathogen and prevent disease. When at risk from unusual or dangerous diseases our body's natural system can be enhanced by the use of vaccination. Since the 1940s a range of antibiotics have been developed which have proved successful against a number of lethal diseases caused by bacteria. Unfortunately many groups of bacteria have now become resistant to these antibiotics. The race is now on to develop a new set of antibiotics. **Bioenergetics:** In this section we will explore how plants harness the Sun's energy in photosynthesis in order to make food. This process liberates oxygen which has built up over millions of years in the Earth's atmosphere. Both animals and plants use this oxygen to oxidise food in a process called aerobic respiration which transfers the energy that the organism needs to perform its functions. Conversely, anaerobic respiration does not require oxygen to transfer energy. During vigorous exercise the human body is unable to supply the cells with sufficient oxygen and it switches to anaerobic respiration. This process will supply energy but also causes the build-up of lactic acid in muscles which causes fatigue. **Forces and motion:** In this section, students will learn about the ways that objects move and how this is linked to the forces that are in action within a system. This can help us to understand the best way to design mechanical machines that work in an elegant and high performance way, from kitchen appliances, professional sport through to vehicle design.	

Please note that topic order will vary from group to group. This is due to the rota system used in Science that is necessary in order to ensure that all students can have access to practical Science opportunities, as there is limited equipment and apparatus available within the school.

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YEAR 10	**Health and Safety** Plan experiments that identify and control risks. Carry out a risk assessment as part of planning an investigation (Chemistry Metals; Physics Electricity)	**Ethical issues** Use knowledge and evidence to understand the ethical issues faced by scientists. (Biology Homeostasis)	**Applications of Science** How science can be used in the modern World. Consider future World needs and how science can help to serve these. (Chemistry Organic; Physics Waves)	**Consider evidence** Analyse graphs and data tables to recognize trends in data. Link patterns in data to developing scientific theory (Biology Inheritance and Variation; Physics Atomic Structure)	**Making accurate observations** Use observation skills to evaluate the properties of different substances. (Chemistry Earth and Atmosphere; Physics Magnetism)	**Completing reliable investigations** Construct detailed plans for investigations that evaluate all risks and control appropriate variables. Record reliable data and construct appropriate graphs (Biology Ecology; Chemistry Reactions of Acids)

AUTUMN 1	AUTUMN 2	SPRING 1	SPRING 2	SUMMER 1	SUMMER 2
Electricity: Electric charge is a fundamental property of matter everywhere. Understanding the difference in the microstructure of conductors, semiconductors and insulators makes it possible to design components and build electric circuits. Many circuits are powered with mains electricity, but portable electrical devices must use batteries of some kind. Electrical power fills the modern world with artificial light and sound, information and entertainment, remote sensing and control. The fundamentals of electromagnetism were worked out by scientists of the 19th century. However, power stations, like all machines, have a limited lifetime. If we all continue to demand more electricity this means building new power stations in every generation – but what mix of power stations can promise a sustainable future?	**Chemical changes:** Understanding of chemical changes began when people began experimenting with chemical reactions in a systematic way and organizing their results logically. Knowing about these different chemical changes meant that scientists could begin to predict exactly what new substances would be formed and use this knowledge to develop a wide range of different materials and processes. It also helped biochemists to understand the complex reactions that take place in living organisms. The extraction of important resources from the earth makes use of the way that some elements and compounds react with each other and how easily they can be 'pulled apart'. **Homeostasis:** Cells in the body can only survive within narrow physical and chemical limits. They require a constant temperature and pH as well as a constant supply of dissolved food and water. In order to do this the body requires control systems that constantly monitor and adjust the composition of the blood and tissues. These control systems include receptors which sense changes and effectors that bring about changes. In this section we will explore the structure and function of the nervous system and how it can bring about fast responses. We will also explore the hormonal system which usually brings about much slower changes. Hormonal coordination is particularly important in reproduction since it controls the menstrual cycle. An understanding of the role of hormones in reproduction has allowed scientists to develop not only contraceptive drugs but also drugs which can increase fertility.	**Particle model and energy resources:** The particle model is widely used to predict the behaviour of solids, liquids and gases and this has many applications in everyday life. It helps us to explain a wide range of observations and engineers use these principles when designing vessels to withstand high pressures and temperatures, such as submarines and spacecraft. It also explains why it is difficult to make a good cup of tea high up a mountain! **Organic chemistry and the atmosphere:** The chemistry of carbon compounds is so important that it forms a separate branch of chemistry. A great variety of carbon compounds is possible because carbon atoms can form chains and rings linked by C-C bonds. This branch of chemistry gets its name from the fact that the main sources of organic compounds are living, or once-living materials from plants and animals. These sources include fossil fuels which are a major source of feedstock for the petrochemical industry. Chemists are able to take organic molecules and modify them in many ways to make new and useful materials such as polymers, pharmaceuticals, perfumes and flavourings, dyes and detergents. When electrons behave in certain ways they can help form covalent bonds involving non-metals. **Inheritance and variation:** In this section we will discover how the number of chromosomes are halved during meiosis and then combined with new genes from the sexual partner to produce unique offspring. Gene mutations occur continuously and on rare occasions can affect the functioning of the animal or plant. These mutations may be damaging and lead to a number of genetic disorders or death. Very rarely a new mutation can be beneficial and consequently, lead to increased fitness in the individual. Variation generated by mutations and sexual reproduction is the basis for natural selection; this is how species evolve. An understanding of these processes has allowed scientists to intervene through selective breeding to produce livestock with favoured characteristics. Once new varieties of plants or animals have been produced it is possible to clone individuals to produce larger numbers of identical individuals all carrying the favourable characteristic. Scientists have now discovered how to take genes from one species and introduce them in to the genome of another by a process called genetic engineering. In spite of the huge potential benefits that this technology can offer, genetic modification still remains highly controversial.	**Magnetism and atomic structure:** Electromagnetic effects are used in a wide variety of devices. Engineers make use of the fact that a magnet moving in a coil can produce electric current and also that when current flows around a magnet it can produce movement. It means that systems that involve control or communications can take full advantage of this. **Quantitative chemistry:** Chemists use quantitative analysis to determine the formulae of compounds and the equations for reactions. Given this information, analysts can then use quantitative methods to determine the purity of chemical samples and to monitor the yield from chemical reactions. Chemical reactions can be classified in various ways. Identifying different types of chemical reaction allows chemists to make sense of how different chemicals react together, to establish patterns and to make predictions about the behaviour of other chemicals. Chemical equations provide a means of representing chemical reactions and are a key way for chemists to communicate chemical ideas. Energy changes are an important part of chemical reactions. The interaction of particles often involves transfers of energy due to the breaking and formation of bonds. Reactions in which energy is released to the surroundings are exothermic reactions, while those that take in thermal energy are endothermic. These interactions between particles can produce heating or cooling effects that are used in a range of everyday applications. Some interactions between ions in an electrolyte result in the production of electricity. Cells and batteries use these chemical reactions to provide electricity. Electricity can also be used to decompose ionic substances and is a useful means of producing elements that are too expensive to extract any other way. **Rate of chemical change:** Chemical reactions can occur at vastly different rates. Whilst the reactivity of chemicals is a significant factor in how fast chemical reactions proceed, there are many variables that can be manipulated in order to speed them up or slow them down. Chemical reactions may also be reversible and therefore the effect of different variables needs to be established in order to maximise the yield of desired product. Understanding energy changes that accompany chemical reactions is important for this process. In industry, chemists and chemical engineers determine the effect of different variables on reaction rate and yield of product. Whilst there may be compromises to be made, they carry out optimisation processes to ensure that enough product is produced within a sufficient time, and in an energy-efficient way. **Ecology:** The Sun is a source of energy that passes through ecosystems. Materials including carbon and water are continually recycled by the living world, being released through respiration of animals, plants and decomposing microorganisms and taken up by plants in photosynthesis. All species live in ecosystems composed of complex communities of animals and plants dependent on each other and that are adapted to particular conditions, both abiotic and biotic. These ecosystems provide essential services that support human life and continued development. In order to continue to benefit from these services humans need to engage with the environment in a sustainable way. In this section we will explore how humans are threatening biodiversity as well as the natural systems that support it. We will also consider some actions we need to take to ensure our future health, prosperity and well-being.

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YEAR 11	**Maths skills** Construct and use relevant scientific equations. Convert units correctly and calculate mean taking anomalies into consideration (Chemistry Quantitative Chemistry; Physics Waves)	**Key Vocabulary** Use key scientific terms in the correct context to analyse data and answer scientific questions. Design appropriate models. (Biology Inheritance and Reproduction; Chemistry Rate and Yields; Physics Space)	**Scientific Methods** Evaluate different techniques for collecting reliable data. Discuss the advantages and disadvantages of different techniques (Biology Ecology; Chemistry Rate and Yield)	**Graphical Analysis** Compare a range of different data sources to identify trends in data. Carry out further analysis on data including measuring gradients. (Scientific Enquiry for Required Practicals in all Sciences)	**Scientific Methodology** Apply investigative approaches to answer any examination questions linked to scientific data collection (Scientific Enquiry Skills and Revision across all units)	**Consolidation and preparation** Explore more advanced scientific techniques in preparation for further study (Revision of all Units and consolidation of skills)
	Waves: Wave behaviour is common in both natural and man-made systems. Waves carry energy from one place to another and can also carry information. Designing comfortable and safe structures such as bridges, houses and music performance halls requires an understanding of mechanical waves. Modern technologies such as imaging and communication systems show how we can make the most of electromagnetic waves. **Chemical analysis:** Analysts have developed a range of qualitative tests to detect specific chemicals. The tests are based on reactions that produce a gas with distinctive properties, or a colour change or an insoluble solid that appears as a precipitate. Instrumental methods provide fast, sensitive and accurate means of analysing chemicals, and are particularly useful when the amount of chemical being analysed is small. Forensic scientists and drug control scientists rely on such instrumental methods in their work.		**Particle model:** The particle model is widely used to predict the behaviour of solids, liquids and gases and this has many applications in everyday life. It helps us to explain a wide range of observations and engineers use these principles when designing vessels to withstand high pressures and temperatures, such as submarines and spacecraft. It also explains why it is difficult to make a good cup of tea high up a mountain! **Using resources:** Industries use the Earth's natural resources to manufacture useful products. In order to operate sustainably, chemists seek to minimise the use of limited resources, use of energy, waste and environmental impact in the manufacture of these products. Chemists also aim to develop ways of disposing of products at the end of their useful life in ways that ensure that materials and stored energy are utilised. Pollution, disposal of waste products and changing land use has a significant effect on the environment, and environmental chemists study how human activity has affected the Earth's natural cycles, and how damaging effects can be minimised.		**Atomic structure:** Ionising radiation is hazardous but can be very useful. Although radioactivity was discovered over a century ago, it took many nuclear physicists several decades to understand the structure of atoms, nuclear forces and stability. Early researchers suffered from their exposure to ionizing radiation. Rules for radiological protection were first introduced in the 1930s and subsequently improved. Today radioactive materials are widely used in medicine, industry, agriculture and electrical power generation. **Chemistry of the atmosphere:** The Earth's atmosphere is dynamic and forever changing. The causes of these changes are sometimes man-made and sometimes part of many natural cycles. Scientists use very complex software to predict weather and climate change as there are many variables that can influence this. The problems caused by increased levels of air pollutants require scientists and engineers to develop solutions that help to reduce the impact of human activity. **Space:** Questions about where we are, and where we came from, have been asked for thousands of years. In the past century, astronomers and astrophysicists have made remarkable progress in understanding the scale and structure of the universe, its evolution and ours. New questions have emerged recently. 'Dark matter', which bends light and holds galaxies together but does not emit	

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YEAR 12	**Planning investigations** Consider all variables to plan an appropriate investigation. Produce a detailed written method that considers and evaluates risks.	**Following Instructions** Follow written instructions for practical work to make observations and produce a suitable outcome	**Apply Investigative Approaches and Methods** Select appropriate apparatus for the technique planned. Work with precision and accuracy to obtain scientific data	**Comparing methods** Select appropriate apparatus by researching different techniques as part of the planning stage. Identify methods that are reliable and reproducable	**Record accurate data** Transfer observations into quantitative analysis so that appropriate data tables and graphs can be constructed. Consider the causes of anomalies and plan to remove these from data	**Scientific reporting** Link all scientific enquiry skills to write a detailed report on an investigation. Include correct scientific terms for variables and appropriate mathematical analysis of results
YEAR 13	**Maths Skills** Use a range of mathematical skills to evaluate scientific data. Convert data into appropriate significant figures and standard form	**Risk analysis** Write a detailed risk assessment prior to any practical investigation that includes all chemicals and techniques. Use external sources for information to fully evaluate all risks.	**Research and Referencing** Identify relevant literature to compare different scientific methods. Reference correctly the work of other scientists and use this to critically analyse results	**Consolidation of practical skills** Apply all knowledge of scientific skills to fully plan, accurately record observations, analyse results in detail and complete a full evaluation that includes future improvements or extended study.	**Examination practice** Apply scientific enquiry skills in the correct context to fully interpret and answer examination questions	**Portfolio of evidence** Construct a summary portfolio of scientific enquiry skills undertaken to plan for further study