KS4 Science - Medium Term Plan

End Game		Students should be able 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.			
		1st 10 Week Block	**2nd 10 Week Block**	**3rd 10 Week Block**	**4th 10 Week Block**
Year 9	**Fertile Question**	**KS3-> KS4 Bridging**	**Biology Unit 1:** If we were broken in 5 trillion pieces, would many be the same? **Physics Unit 18:** At night, when you are tired, where has all of your energy gone?	**Chemistry Unit 8:** Why are some elements reactive while others are not? **Biology Unit 2:** Why should your body be as organised as your house?	**Physics Unit 21:** Do the drawbacks outweigh the benefits of radioactive energy? **Chemistry Unit 9:** How can moving electrons change elements? **Chemistry Unit 12:** How can we get reactions to give off/take in more heat energy?
	Content		**Biology Unit 1:** • Cellular Biology • Required Practical-Microscopes • Required Practical- Osmosis • 3 GEM TASKS • EOTT **Physics Unit 18:** • Energy Changes • Required Practical-Heat Capacity • 2 GEM TASKS • EOTT	**Biology Unit 2:** • Oganisation • Required Practical- Enzymes • Required Practical- Food Tests • 3 GEM TASKS • EOTT **Chemistry Unit 8:** • Atomic Structure • 2 GEM TASKS • EOTT	**Physics Unit 21** • Atomic Structure • 1 GEM TASK • EOTT **Chemistry Unit 9:** • Bonding • 2 GEM TASKS • EOTT **Chemistry Unit 12:** • Energy Changes • Required Practical- Energy Changes • 1 GEM TASK • EOTT
	Concepts		**Biology Unit 1:** Animal cells, plant cells, microscopes, specialisation, prokaryotic, eukaryotic, cell division, stem cells, and transport in cells. **Physics Unit 18:** Energy stores, GPE, Kinetic Energy, Elastic Potential Energy, Specific Heat Capacity, work done, power, efficiency, renewable and non-renewable energy	**Biology Unit 2:** Cells, tissues, organs, enzymes, digestion, food tests, the heart, gas exchange, blood, health and lifestyle, cancer, plant tissue and structure of the leaf. **Chemistry Unit 8:** Atomic structure, periodic table, properties of mixtures, separation techniques, history of the periodic table, sub atomic particles, electron configuration, metals and non mentals, group 1, group 7 and group 10	**Physics Unit 21:** Atomic structure, radioactive decay, alpha, beta, gamma, half life, safety with radiation. **Chemistry Unit 9:** Ionic bonding, covalent bonding, metallic bonding, structure and bonding of polymers, diamond and graphite. **Chemistry Unit 12:** Exothermic and endothermic reactions, activation energies and bond energies
	Knowledge		**Biology Unit 1:** 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	**Biology Unit 2:** 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	**Physics Unit 21:** 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 ionising radiation. Rules for radiological protection were first introduced in the 1930s and subsequently improved. Today

			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. **Physics Unit 18:** 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.	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. **Chemistry Unit 8:** 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.	radioactive materials are widely used in medicine, industry, agriculture and electrical power generation. **Chemistry Unit 9:** 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. **Chemistry Unit 12:** 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.
Year 10	**Fertile Question**	**Physics Unit 19:** How are current, potential difference and resistance related? **Biology Unit 3:** When you get the chickenpox, why is likely you will not get them again?	**Chemistry Unit 10:** When coal is burnt in a fire, is all of the mass of the coal lost? **Chemistry Unit 11:** How can certain processes change elements? **Physics Unit 20:** When we add/take away heat energy what impact does this have on objects?	**Biology Unit 4:** How do organisms make and use energy? **Biology Unit 5:** Why does our body need to keep conditions the same? **Physics Unit 23:** Do waves only exist in the sea?	**Chemistry Unit 13:** How can manufacturing companies get more product, faster? **Chemistry Unit 14:** How can we separate substances for other uses? **Chemistry Unit 15:** How can we test for the presence of substances? **Chemistry Unit 17:** How are we making use of our earths resources?
	Content	**Physics Unit 19:** • Electricity • Required Practical- Factors that affect resistance • Required Practical- Investigation of V-I with a lamp, diode and resistor • 3 GEM TASKS • EOTT **Biology Unit 3**	**Chemistry Unit 10:** • Quantitative Chemistry • 1 GEM TASKS • EOTT **Chemistry Unit 11:** • Chemical Changes • 3 GEM TASKS • Required Practical- Making Salts • Required Practical- Neutralisation • Required Practical- Electrolysis	**Biology Unit 4:** • Bioenergetics • Required Practical- Photosynthesis • 2 GEM TASKS • EOTT **Biology Unit 5:** • Homeostasis • Required Practical- Reaction Time • 2 GEM TASKS • EOTT	**Chemistry Unit 13:** • Rates of Reaction • 2 GEM TASKS • Required Practical- Effect of Concentration • EOTT **Chemistry Unit 14:** • Organic Chemistry • 1 GEM TASK

		• Infectious Diseases • 2 GEM TASKS • EOTT	• EOTT **Physics Unit 20:** • Particle Model • 2 GEM Tasks • Required Practical- Determining density • EOTT	**Physics Unit 23** • Waves • 1 GEM TASK • Required Practical- Measuring Frequency • Required Practical- Light	• EOTT **Chemistry Unit 15:** • Chemical Analysis • 1 GEM TASK • Required Practical- Chromatography • EOTT **Chemistry Unit 17:** • Resources • 2 GEM TASKS • Required Practical- Purification of Water • EOTT
	Concepts	**Physics Unit 19:** Circuit symbols, current, P.D, resistance, ohms law, series and parallel circuits, AC and DC, plugs, calculating power, work done on charge, the national grid, **Biology Unit 3** Communicable diseases, culturing microorganisms, human defence, vaccinations, antibiotics, painkillers and drug development	**Chemistry Unit 10:** Conservation of mass, balanced equations, relative formula mass, moles, calculating concentrations. **Chemistry Unit 11:** Metal Oxides, extraction and reactivity of metals, oxidation and reduction, reactions with acids, making salts, pH, acids and alkalis, ionic solutions, electrolysis and half equations **Physics Unit 20:** Particle model, states of matter, density, chemical and physical changes, SHC, latent heat, gases	**Biology Unit 4:** Photosynthesis, limiting factors, uses of glucoses, aerobic and anaerobic respiration and metabolism. **Biology Unit 5:** The nervous system, the endocrine system, regulation of glucose, regulation of nitrogen and water, the kidney, hormone control in reproduction, contraception and fertility, negative feedback systems. **Physics Unit 23** Properties of waves, transverse and longitundianl, EM waves,	**Chemistry Unit 13:** Rates of reaction, collision theory, effect of temperature, effect of concentration, catalyst, reversible reactions, Le Chateliers principle and effect of pressure **Chemistry Unit 14:** Carbon compounds for fuel, fractional distillation, trends and cracking **Chemistry Unit 15:** Separation of mixtures, chromatography, test for hydrogen, oxygen, chlorine and carbon dioxide **Chemistry Unit 17:** Water, purification, sewage, extraction of copper, life cycle assessment, recycling

	Knowledge	**Biology Unit 3** 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 **Physics Unit 19:** 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?	**Chemistry Unit 10:** 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. **Chemistry Unit 11:** Understanding of chemical changes began when people began experimenting with chemical reactions in a systematic way and organising 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'. **Physics Unit 20:** 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!	**Biology Unit 4** 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 **Biology Unit 5:** 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. **Physics Unit 23** 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.	**Chemistry Unit 13:** 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 identify how 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 **Chemistry Unit 14:** 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 **Chemistry Unit 15:** 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.

					Chemistry Unit 17: 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.
Year 11	**Fertile Question**	**Physics Unit 22:** How can equations help us understand how objects move? **Physics Unit 24:** How are magnetism and electricity linked?	**Biology Unit 6:** Why do you look similar to your sibling but not the exact same? **Biology Unit 7:** How are species and their environment related? **Chemistry Unit 16:** We don't live in the sky so how do we influence the environment there?	**REVISION BASED UPON QLA**	**REVISION BASED UPON QLA**
	Content	**Physics Unit 22:** • Forces • 5 GEM TASK • Required Practical- Extension of a spring • Required Practical- Force and Acceleration • EOTT **Physics Unit 24:** • Magnetism and Electromagnetism • 1 GEM TASK • EOTT	**Biology Unit 6:** • Inheritance, variation and evolution • 2 GEM TASKS • EOTT **Biology Unit 7:** • Ecology • Required Practical- Field Investigation • 3 GEM TASKS • EOTT **Chemistry Unit 16:**		
	Concepts	**Physics Unit 22:** Scalers and vectors, weight, resultant force, work done, changing shape, Hooke's law, displacement, speed, velocity, distance-time graphs, acceleration/deccleration, gravity, Newton's 1^{st}, 2^{nd} and 3^{rd} laws, stopping distances, reaction time, momentum **Physics Unit 24:** Permanent and induced magnets, compasses, motor effect, Fleming's left hand rule	**Biology Unit 6:** Sexual and Asexual reproduction, DNA structure, genetic crosses and disorders, genetic engineering, variation, selective breeding, evolution, extinction and classification. **Biology Unit 7:** Classification, biotic and abiotic factors, distribution, adaptations, decay, biodiversity, pollution, deforestation and global warming. **Chemistry Unit 16:**		
	Knowledge	**Physics Unit 22:** 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	**Biology Unit 6:** 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		

		in this way. Recent developments in artificial limbs use the analysis of forces to make movement possible. **Physics Unit 24:** 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	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. **Biology Unit 7:** 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 **Chemistry Unit 16:** 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		