Separate Science Key Stage 4

Curriculum Overview

The Rowan Learning Trust

KS4 Separate Science Long Term Plan (AQA Biology, Chemistry, Physics)

Y10 Biology	**Week 1** ◄——————————————————————————————————————► **Week 39**			
Topic	B4 Bioenergetics	B1 Cells	B2 Organisation	B3 Infection and response
Key Content Know that... (Substantive Knowledge) Know how…. (Disciplinary knowledge)	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. **Maths Skills** 1a – Recognise and use expressions in decimal form 1c- Use ratios, fractions and percentages 2c – Construct and interpret frequency tables and diagrams, bar charts and histograms 3a- Understand and use the symbols: =, <, <<, >>, >, ∝ , ~ 3d – Solve simple algebraic	Cells are the basic unit of all forms of life. In this section we explore how structural differences between types of cells enable 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. **Maths Skills** 1a Recognise and use expressions in decimal form 1b Recognise and use expressions in standard form 1c Use ratios, fractions and percentages 1d Make estimates of the results of simple calculations 2a Use an appropriate number of significant figures	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. **Maths skills** 1a - Recognise and use expressions in decimal form 1c - Students should be able to develop an understanding of size and scale in relation to cells, tissues, organs and	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 **Working scientifically** WS 1.3 Appreciate the power of monoclonal antibodies and consider any ethical

	equations. 4a – Translate information between graphical and numeric form 4c – Plot two variables from experimental or other data **Working Scientifically** (HT only) WS 1.4 Use data to relate limiting factors to the cost effectiveness of adding heat, light or carbon dioxide to greenhouses. **Apparatus and Techniques** AT 1, 3, 4 Investigations into the effect of exercise on the body. AT1 - Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, temperature, volume of liquids and gases, and Ph AT3 - Use of appropriate apparatus and techniques for the observation and measurement of biological changes and/or processes. AT4 - Safe and ethical use of living organisms (plants or animals) to measure physiological functions and responses to the environment	2h Make order of magnitude calculations 3a Understand and use the symbols: =, <, <<, >>, >, ∝ , ~ 4a Translate information between graphical and numeric form 4b Understand that y = mx + c represents a linear relationship 4c Plot two variables from experimental or other data 4d Determine the slope and intercept of a linear graph 5c Calculate areas of triangles and rectangles, surface areas and volumes of cubes MS 1a, 1b, 1d, 2a, 2h Calculate the number of bacteria in a population after a certain time if given the mean division time. MS 5c Calculate cross-sectional areas of colonies or clear areas around colonies using πr^2. **Working Scientifically** WS1.1 Understand how scientific methods and theories develop over time. WS 1.2 Recognise, draw and interpret images of cells Use models and analogies to develop explanations of how cells divide. Recognise, draw and interpret diagrams that model diffusion	systems. 2a Use an appropriate number of significant figures 2c - Construct and interpret frequency tables and diagrams, bar charts and histograms 2d Understand the principles of sampling as applied to scientific data (biology questions only) 2g Use a scatter diagram to identify a correlation between two variables (biology and physics questions only) 4a- Translate information between graphical and numeric form 4d - Determine the slope and intercept of a linear graph 5c - Process data from investigations involving stomata and transpiration rates to find arithmetic means, understand the principles of sampling and calculate surface areas and volumes. **Working scientifically** 1.2 Students should be able to use other models to explain enzyme action. WS 1.3 Evaluate methods of treatment bearing in mind the benefits and risks associated with the treatment. WS 1.4 Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions	issues. WS 1.4 Evaluate the global use of vaccination in the prevention of disease. WS 1.4 The everyday application of scientific knowledge to detect and identify plant disease. WS 1.4 The understanding of ion deficiencies allows horticulturists to provide optimum conditions for plants. WS 1.5 Evaluate the advantages and disadvantages of monoclonal antibodies. WS 1.6 Understand that the results of testing and trials are published only after scrutiny by peer review .

	Required practical activity 6: investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed. AT skills covered by this practical activity: AT 1, 2, 3, 4 and 5.	WS 1.2 Recognise, draw and interpret diagrams that model osmosis WS 1.3 Evaluate the practical risks and benefits, as well as social and ethical issues, of the use of stem cells in medical research and treatments. WS 1.5 Use of isotonic drinks and high energy drinks in sport. WS 4.4 Use prefixes centi, milli, micro and nano **Apparatus and Techniques** AT 7 Images of cells in videos, bio viewers, photographs and micrographs can be used as comparison for students own drawings. Required practical activity 1: use a light microscope to observe, draw and label a selection of plant and animal cells. A magnification scale must be included. AT skills covered by this practical activity: biology AT 1 and 7. Required practical activity 2: investigate the effect of antiseptics or antibiotics on bacterial growth using agar plates and measuring zones of inhibition. AT skills covered by this practical activity: AT 1, 3, 4 and 8.	based on the evaluation of evidence and arguments WS 1.5 Evaluate risks related to use of blood products. Interpret data about risk factors for specified diseases. WS 3.5 Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. **Apparatus and Techniques** AT 7 Observing and drawing blood cells seen under a microscope. AT 7 Observation and drawing of a transverse section of leaf. AT 3, 4, 5 Measure the rate of transpiration by the uptake of water. AT 6, 7 Investigate the distribution of stomata and guard cells. Required practical activity 4: use qualitative reagents to test for a range of carbohydrates, lipids and proteins. To include: Benedict's test for sugars; iodine test for starch; and Biuret reagent for protein.	

		Required practical activity 3: investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue. AT skills covered by this practical activity: AT 1, 3 and 5.	AT skills covered by this practical activity: AT 2 and 8. Required practical activity 5: investigate the effect of pH on the rate of reaction of amylase enzyme. Students should use a continuous sampling technique to determine the time taken to completely digest a starch solution at a range of pH values. Iodine reagent is to be used to test for starch every 30 seconds. Temperature must be controlled by use of a water bath or electric heater. AT skills covered by this practical activity: AT 1, 2, 5 and 8.	
Prior knowledge	Y7 Plant reproduction Y8 Photosynthesis Y8 Respiration	Y7 Variation Y8 Cells Y9 Breathing Y9 Digestion	Y7 Plant reproduction Y8 Photosynthesis Y8 Movement Y8 Cells Y9 Breathing Y9 Digestion	Y8 Photosynthesis Y9 Digestion
GCSE assessment objectives	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions

	• develop and improve experimental procedures	develop and improve experimental procedures	develop and improve experimental procedures	develop and improve experimental procedures
Assessment tasks	Prior knowledge check Extended response questions on 4.4.1 photosynthesis and 4.4.2 respiration End of topic assessment	Prior knowledge check Extended response questions on 4.1.1 cell structure 4.1.2 cell division 4.1.3 cell transport End of topic assessment	Prior knowledge check Extended response questions on 4.2.1 Principles of organisation 4.2.2 Animal tissues, organs and organ systems 4.2.3 Plant tissues, organs and systems End of topic assessment	Prior knowledge check Extended response questions on 4.3.1 Communicable diseases 4.3.2 Monoclonal antibodies (biology only) (HT only) 4.3.3 Plant disease (biology only) End of topic assessment

Y11 Biology	Week 1 ⟵		⟶ Week 39
Topic	B7 Ecology	B6 Inheritance and variation	B5 Homeostasis
Key Content **Know that... (Substantive Knowledge)** **Know how…. (Disciplinary knowledge)**	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. **Maths skills** MS 1c Use ratios, fractions and percentages Calculate the efficiency of biomass transfer between trophic levels. 2b Find arithmetic means 2c Construct and interpret frequency tables and diagrams, bar charts and histograms. 2f Understand the terms mean, mode and median 4a Translate information between graphical and numeric form	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. **Maths skills** 1c Use ratios, fractions and percentages 2c, 4a Extract and interpret information from charts, graphs and tables 2e Understand simple probability (biology questions only) 3a Understand and use the symbols: =, <, <<, >>, >, ∝ , ~	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. **Maths skills** 2c Construct and interpret frequency tables and diagrams, bar charts and histograms 4a Translate information between graphical and numeric form **Working scientifically** WS 1.3 Evaluate information around the relationship between obesity and diabetes, and make recommendations taking into account social and ethical issues. WS 1.3 Show why issues around contraception cannot be answered by science alone.

	4c Plot two variables from experimental or other data MS 2c, 4a Extract and interpret information from charts, graphs and tables **Working scientifically** WS 1.2 Interpret graphs used to model predator-prey cycles WS 1.2 Interpret and explain the processes in diagrams of the carbon cycle, the water cycle. WS 2.6 Recording first-hand observations of organisms. WS 1.4 Explain how waste, deforestation and global warming have an impact on biodiversity. WS 1.4, 1.5 Understand the conflict between the need for cheap available compost to increase food production and the need to conserve peat bogs and peatlands as habitats for biodiversity and to reduce carbon dioxide emissions. WS 1.4 Evaluate the environmental implications of deforestation. WS 1.6 Understand that the scientific consensus about global warming and climate change is based on systematic reviews of thousands of peer reviewed publications. WS 1.3 Explain why evidence is uncertain or incomplete in a complex context	**Working scientifically** WS 1.1 Historical developments of our understanding of the causes and prevention of malaria. WS 1.2 Interpret a diagram of DNA structure but will not be required to reproduce it. WS 1.2 Modelling insertions and deletions in chromosomes to illustrate mutations. WS 1.2 Modelling behaviour of chromosomes during meiosis WS 1.3 Appreciate that embryo screening and gene therapy may alleviate suffering but consider the ethical issues which arise. WS 1.2 Use the theory of evolution by natural selection in an explanation. WS 1.1, 1.3 Students should appreciate that the theory of evolution by natural selection developed over time and from information gathered by many scientists. WS 1.1 The theory of speciation has developed over time. WS 1.1 Our current understanding of genetics has developed over time WS 1.3, 1.4 Explain the benefits and risks of selective breeding given appropriate information and consider related ethical issues (HT only) WS 1.4 Interpret information about genetic engineering techniques and to make	WS 1.4 Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments (HT only) WS 1.1 Developments of microscopy techniques have enabled IVF treatments to develop. WS 1.3 Understand social and ethical issues associated with IVF treatments. (HT only) WS 1.4 Evaluate from the perspective of patients and doctors the methods of treating infertility. (HT only) WS 1.2, MS 2c Interpret and explain simple diagrams of negative feedback control. (HT only) WS 1.5 Evaluate the benefits and risks of procedures carried out on the brain and nervous system. WS 1.4 Students should be able to describe how kidney dialysis works. WS 1.5 Evaluate the advantages and disadvantages of treating organ failure by mechanical device or transplant. WS 1.3, 1.4 Understand how the everyday use of hormones as weed killers has an effect on biodiversity Required practical activity 7: plan and carry out an investigation into the effect of a factor on human reaction time. AT skills covered by this practical activity: AT 1, 3 and 4 Required practical activity 8: investigate the effect of light or gravity on the growth of newly germinated seedlings.

	WS 1.4, 1.5 Evaluate given information about methods that can be used to tackle problems caused by human impacts on the environment. Explain and evaluate the conflicting pressures on maintaining biodiversity given appropriate information WS 1.4 Interpret population and food production statistics to evaluate food security WS 1.3 Understand that some people have ethical objections to some modern intensive farming methods. WS 1.4 Evaluate the advantages and disadvantages of modern farming techniques. WS 1.4 Understand how application of different fishing techniques promotes recovery of fish stocks Required practical activity 9: measure the population size of a common species in a habitat. Use sampling techniques to investigate the effect of a factor on the distribution of this species. AT skills covered by this practical activity: AT 1, 3, 4, 6 and 8. Required practical activity 10: investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change. AT skills covered by this practical activity: AT 1, 3, 4 and 5.	informed judgements about issues concerning cloning and genetic engineering, including GM crops. WS 1.3, 1.4 Explain the potential benefits and risks of cloning in agriculture and in medicine and that some people have ethical objections. WS 1.3 Data is now available to support the theory of Evolution WS 1.3 Appreciate why the fossil record is incomplete. WS 1.1 Understand how scientific methods and theories develop over time. WS 1.2 Interpret evolutionary trees.	Record results as both length measurements and as careful, labelled biological drawings to show the effects. AT skills covered by this practical activity: AT 1, 3, 4 and 7
Prior knowledge	Y7 interdependence Y7 Variation Y8 Respiration	Y7 Variation Y7 Human reproduction Y8 Photosynthesis	Y7 Plant reproduction Y7 Interdependence Y7 Human reproduction

	Y9 Evolution Y9 Climate	Y9 Inheritance Y9 Evolution	Y8 Respiration Y8 Photosynthesis Y8 Light
GCSE assessment objectives	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusion develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions develop and improve experimental procedures
Assessment tasks	Prior knowledge check Extended response questions on 4.7.1 Adaptations, interdependence and competition 4.7.2 Organisation of an ecosystem 4.7.3 Biodiversity and the effect of human interaction on ecosystems 4.7.4 Trophic levels in an ecosystem (biology only) End of topic assessment	Prior knowledge check Extended response questions on 4.6.1 Reproduction 4.6.2 Variation and evolution 4.6.3 The development of understanding of genetics and evolution 4.6.4 Classification of living organisms End of topic assessment	Prior knowledge check Extended response questions on 4.5.1 Homeostasis 4.5.2 The human nervous system 4.5.3 Hormonal coordination in humans 4.5.4 Plant hormones (biology only) End of topic assessment

Y10 Chemistry	Week 1 ◄				Week 39 ►
Topic	C1 Atomic structure and the periodic table	C2 Bonding and structure	C3 Quantitative chemistry	C4 Chemical changes	C5 Energy changes
Key Content **Know that... (Substantive Knowledge)** **Know how…. (Disciplinary knowledge)**	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. **Maths skills** 1b Recognise and use expressions in standard form 1d Recognise expressions in standard form 5b Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects	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. **Maths Skills** 1a Recognise and use expressions in decimal form 1b Recognise and use expressions in standard form. 1c Use ratios, fractions and percentages 1d Make estimates of the results of simple calculations. 2h Make order of magnitude calculations.	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. **Maths Skills** MS 1a - Recognise and use expressions in decimal form. MS 1b -Recognise and use	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’. **Maths skills** MS 2h Make order of magnitude calculations. **Working scientifically**	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. **Maths skills** MS 1a Recognise and use expressions in decimal

	Working scientifically 1.1 Understand how scientific methods and theories develop over time 1.2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts 1.6 Recognise the importance of peer review of results and of communicating results to a range of audiences. Students should be able to represent the electronic structures of the first twenty elements of the periodic table in both forms Explain how testing a prediction can support or refute a new scientific idea. 2.2 Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena 2.3 Apply a knowledge of a range of techniques, instruments, apparatus, and	4a Translate information between graphical and numeric form MS 5b - Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects. MS 5c Calculate areas of triangles and rectangles, surface areas and volumes of cubes. **Working scientifically** 1.2 Recognise substances as small molecules, polymers or giant structures from diagrams showing their bonding. Recognise substances as metallic giant structures from diagrams showing their bonding. 1.4 Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments. 1.3 Appreciate the power and limitations of science and consider any ethical issues which may arise. 1.5 Evaluate risks both in practical science and the	expressions in standard form. MS 1c-Use ratios, fractions and percentages. MS 2a-Use an appropriate number of significant figures. MS 3a- Understand and use the symbols: =, <, <<, >>, >, ∝, ~ MS 3b-Change the subject of an equation MS 3c Substitute numerical values into algebraic equations using appropriate units for physical quantities. **Working Scientifically** WS 1.2 1.2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts 3.4 Representing distributions of results and make estimations of uncertainty. 4.1 Use scientific vocabulary, terminology and definitions 4.2 Recognise the importance of scientific quantities and understand how they are determined	WS 1.2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. **Apparatus and Techniques** AT 6 Mixing of reagents to explore chemical changes and/or products. AT 3 This is an opportunity to investigate pH changes when a strong acid neutralises a strong alkali. Required practical 1: preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution. AT skills covered by this practical activity: 2, 3, 4 and 6 Required practical 2: (chemistry only)	form. **Apparatus and Techniques** AT 5 An opportunity to measure temperature changes when substances react or dissolve in water. AT6 Safe and careful use of Liquids. Required practical 4: investigate the variables that affect temperature changes in reacting solutions such as, eg acid plus metals, acid plus carbonates, neutralisations, displacement of metals. AT skills covered by this practical activity: 1, 3, 5 and 6

	materials to select those appropriate to the experiment. 4.3 Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate 4.4 Use SI units and the prefix nano. **Apparatus and techniques** AT 4 Safe use of a range of equipment to separate chemical mixtures. AT 6 Offers an opportunity within displacement reactions of halogens.	wider societal context, including perception of risk in relation to data and consequences. 4.1 Use scientific vocabulary, terminology and definitions. 4.2 Recognise the importance of scientific quantities and understand how they are determined 4.3 Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate 4.4 Use prefixes and powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano). 4.5 Interconvert units.	4. 3 Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate 4.5 Interconvert units. 4.6 Use an appropriate number of significant figures in calculation **Apparatus and Techniques** AT 1, 2,6 Opportunities within investigation of mass changes using various apparatus. AT 1, 3, 8 Opportunities within titrations including to determine concentrations of strong acids and alkalis.	determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration. (HT only) determination of the concentration of one of the solutions in mol/dm3 and g/dm3 from the reacting volumes and the known concentration of the other solution. AT skills covered by this practical activity: 1 and 8. Required practical 3: investigate what happens when aqueous solutions are electrolysed using inert electrodes. This should be an investigation involving developing a hypothesis. AT skills covered by this practical activity: 3, 7 and 8.	
Prior knowledge	Y7 Separating mixtures Y8 Elements Y8 Periodic table Y9 Types of reaction	Y7 Particle model Y7 Metals and non-metals Y8 Earth structure Y8 Elements	Y9 Types of reaction	Y7 Acids and alkalis Y7 Metals and non-metals Y9 Types of reaction	Y9 Types of reaction Y9 Chemical energy
GCSE assessment objectives	AO1: Demonstrate knowledge and understanding of: • scientific ideas	AO1: Demonstrate knowledge and understanding of: • scientific ideas	AO1: Demonstrate knowledge and understanding of: • scientific ideas	AO1: Demonstrate knowledge and understanding of: • scientific ideas	AO1: Demonstrate knowledge and understanding of: • scientific ideas

	• scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	• scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	• scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	• scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	• scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures
Assessment tasks	Prior knowledge check Extended response questions on 4.1.1 A simple model of the atom, symbols, relative atomic mass, electronic charge and isotopes. 4.1.2 The periodic table. End of topic assessment	Prior knowledge check Extended response questions on 4.2.1 Chemical bonds, ionic, covalent and metallic 4.2.2 How bonding and structure are related to the properties of Substances 4.2.3 Structure and bonding of carbon 4.2.4 Bulk and surface properties of matter including nanoparticles (chemistry only) End of topic assessment	Prior knowledge check Extended response questions on 4.3.1 Chemical measurements, conservation of mass and the quantitative interpretation of chemical equations. 4.3.2 Use of amount of substance in relation to masses of pure substances 4.3.3 Yield and atom economy of chemical reactions (chemistry only) 4.3.4 Using concentrations of solutions in mol/dm3 (chemistry only) (HT only) 4.3.5 Use of amount of substance in relation to volumes of gases (chemistry only) (HT only) End of topic assessment	Prior knowledge check Extended response questions on 4.4.1 Reactivity of metals 4.4.2 Reactions of acids 4.4.3 Electrolysis End of topic assessment	Prior knowledge check Extended response questions on 4.5.1 Exothermic and endothermic reactions 4.5.2 Chemical cells and fuel cells (chemistry only) End of topic assessment

Y11 Chemistry	Week 1 ◄				Week 39 ►
Topic	C6 Rates of reaction	C7 Organic Chemistry	C8 Chemical analysis	C9 Chemistry of the atmosphere	C10 using resources
Key Content **Know that... (Substantive Knowledge)** **Know how…. (Disciplinary knowledge)**	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.	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. **Maths skills** MS 5b Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects.	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. **Maths skills** MS 1a Recognise and use expressions in decimal form. MS 1c Use ratios, fractions and percentages. MS 1d Make estimates of the results of simple calculations.	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. **Working scientifically** 1.1 Understand how scientific methods and theories develop over time 1.2 Use a variety of models such as representational, spatial, descriptive, computational, and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts	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. **Maths skills** MS 1a Recognise and use expressions in decimal form. MS 1c Use ratios, fractions and percentages MS 1d Make estimates of the results of simple calculations

	Maths skills MS 1a Recognise and use expressions in decimal form. MS 1c Use ratios, fractions and percentages. MS 1d Make estimates of the results of simple calculations. MS 4a Translate information between graphical and numeric form. MS 4b Drawing and interpreting appropriate graphs from data to determine rate of reaction. MS 4c Plot two variables from experimental or other data. MS 4d Determine the slope and intercept of a linear graph. MS 4e Draw and use the slope of a tangent to a curve as a measure of rate of change. MS 5C Calculate areas of triangles and rectangles, surface areas and volumes of cubes. **Working scientifically** WS 1.2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve	**Working scientifically** WS 1.2 Make models of alkane molecules using the molecular modelling kits. WS 1.2, 4.1 Investigate the properties of different hydrocarbons. WS 1.2 Recognise substances that are alkenes from their names or from given formulae in these forms. WS 1.2 Use models to represent addition polymerisation. WS 1.2 Use models to represent condensation polymerisation. **Apparatus and techniques** AT 2, 5, 6 Opportunities when investigating reactions of alcohols. AT 2, 5, 6 Opportunities within investigation of the reactions of carboxylic acids.	MS4a Translate information between graphical and numeric form. **Working scientifically** WS 1.4Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments WS 2.2 Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. WS 2.3 Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS 3.1 Presenting observations and other data using appropriate methods. WS3.6 WS 4.1 Use scientific vocabulary, terminology and definitions.	1.3 Appreciate the power and limitations of science and consider any ethical issues which may arise. 1.5 Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences. 1.6 Recognise the importance of peer review of results and of communicating results to a range of audiences. 3.5 Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. 3.6 Presenting reasoned explanations including relating data to hypotheses. 4.1 Use scientific vocabulary, terminology and definitions. WS 1.2 An opportunity to show that aquatic plants produce oxygen in daylight.	MS 2a Use an appropriate number of significant figures. 2c Construct and interpret frequency tables and diagrams, bar charts and histograms MS 2h Translate information between graphical and numeric form. 4a Translate information between graphical and numeric form **Working scientifically** WS 3.2 WS 1.3, 4, 5 LCAs should be done as a comparison of the impact on the environment of the stages in the life of a product, and only quantified where data is readily available for energy, water, resources and wastes. Interpret LCAs of materials or products given appropriate information WS 2.2, 7, 3.5 Investigate the conditions for rusting. WS 1.4, 3.5, 3.8 Compare the properties of thermosetting and thermosoftening polymers WS 3.5 WS 3.8 **Apparatus and techniques** AT 4 Prepare an ammonium salt.

	problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts **Apparatus and techniques** AT 5 An opportunity to investigate the catalytic effect of adding different metal salts to a reaction such as the decomposition of hydrogen peroxide. Required practical 5: investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced and a method involving a change in colour or turbidity. This should be an investigation involving developing a hypothesis. AT skills covered by this practical activity: 1, 3, 5 and 6.		**Apparatus and techniques** AT 8 An opportunity to investigate flame colours. AT 8 An opportunity to make precipitates of metal hydroxides. AT 8 An opportunity to observe flame spectra using a handheld spectroscope. Required practical 6: investigate how paper chromatography can be used to separate and tell the difference between coloured substances. Students should calculate Rf values. AT skills covered by this practical activity: 1 and 4. Required practical 7: use of chemical tests to identify the ions in unknown single ionic compounds covering the ions from sections Flame tests (page 73) to Sulfates (page 74) in the Spec. AT skills covered by this practical activity: 1 and 8		Required practical 8: analysis and purification of water samples from different sources, including pH, dissolved solids and distillation. AT skills covered by this practical activity: 2, 3 and 4

Prior knowledge	Y9 Types of reaction	Y8 Elements Y9 Types of reaction	Y7 Separating mixtures	Y9 Types of reaction Y9 Climate	Y8 Earth structure Y9 Climate Y9 Earth's resources
GCSE assessment objectives	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures
Assessment tasks	Prior knowledge check Extended response questions on 4.6.1 Rate of reaction 4.6.2 Reversible reactions and dynamic equilibrium End of topic assessment	Prior knowledge check Extended response questions on 4.7.1 Carbon compounds as fuels and feedstock 4.7.2 Reactions of alkenes and alcohols (chemistry only) 4.7.3 Synthetic and naturally occurring polymers (chemistry only) End of topic assessment	Prior knowledge check Extended response questions on 4.8.1 Purity, formulations and chromatography 4.8.2 Identification of common gases 4.8.3 Identification of ions by chemical and spectroscopic means (chemistry only) End of topic assessment	Prior knowledge check Extended response questions on 4.9.1 The composition and evolution of the Earth's atmosphere 4.9.2 Carbon dioxide and methane as greenhouse gases. 5.9.3 Common atmospheric pollutants and their sources End of topic assessment	Prior knowledge check Extended response questions on 4.10.1 Using the Earth's resources and obtaining potable water 4.10.2 Life cycle assessment and recycling 4.10.3 Using materials (chemistry only) 4.10.4 The Haber process and the use of NPK fertilisers (chemistry only End of topic assessment

Y10 Physics	Week 1 ◄				Week 39 ►
Topic	P1 Energy	P2 Electricity	P3 Particle model	P4 Atomic structure	P5 Forces
Key Content Know that... (Substantive Knowledge) Know how…. (Disciplinary knowledge)	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. **Maths Skills** 1a Recognise and use expressions in decimal form 1c Use ratios, fractions and percentages 2c Construct and interpret frequency tables and diagrams, bar charts and histograms 3b Change the subject of an equation 3c Substitute numerical values into algebraic equations using appropriate units for physical quantities (chemistry and physics questions only) 4a Translate information between graphical and numeric form	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? **Maths skills**	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! **Maths skills** 1a Recognise and use expressions in decimal form 1bRecognise and use expressions in standard form 1c Use ratios, fractions and percentages 3b Change the subject of an equation 3c Substitute numerical values into algebraic equations using appropriate units for physical quantities (chemistry and physics questions only) 3d Solve simple algebraic equations (biology and physics questions only)	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 radioactive materials are widely used in medicine, industry, agriculture and electrical power generation **Maths skills** 1b Recognise and use expressions in standard form 1c Use ratios, fractions and percentages 3c Substitute numerical values into algebraic equations using appropriate units for physical quantities (chemistry and physics questions only)	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. **Maths skills** 1a Recognise and use expressions in decimal form 1c Use ratios, fractions and percentages 1d Make estimates of the results of simple calculations 2f Understand the terms mean, mode and median 3a Students should recognise and be able to use the symbol for proportionality, $\propto$ 3b Change the subject of an equation 3c Substitute numerical values into algebraic equations using appropriate units for physical quantities (chemistry and physics questions only)

	Working scientifically 1.2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. 1.3 Appreciate the power and limitations of science and consider any ethical issues which may arise 1.4 Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments 3.5 Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. 4.3 Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate.	1c Use ratios, fractions and percentages 3b Change the subject of an equation 3c Substitute numerical values into algebraic equations using appropriate units for physical quantities (chemistry and physics questions only) Students should be able to recall and apply equations. 3d Solve simple algebraic equations (biology and physics questions only) 4c Plot two variables from experimental or other data 4d Determine the slope and intercept of a linear graph 4e Draw and use the slope of a tangent to a curve as a measure of rate of change (chemistry and physics questions only) **Working scientifically** 1.2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts.	4a Translate information between graphical and numeric form **Working scientifically** 1.2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. **Apparatus and techniques** AT 5 Perform an experiment to measure the latent heat of fusion of water Required practical activity 5: use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solid objects and liquids. Volume should be determined from the dimensions of regularly shaped objects, and by a displacement technique for irregularly shaped objects. Dimensions to be measured using appropriate apparatus such as a ruler, micrometer or Vernier callipers.	(HT only) 3d Solve simple algebraic equations (biology and physics questions only) **Working scientifically** 1.1 Understand how scientific methods and theories develop over time. 1.2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. 1.4 Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments 1.5 Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences 1.6 Recognise the importance of peer review	4a Translate information between graphical and numeric form 4b Understand that y = mx + c represents a linear relationship 4c Plot two variables from experimental or other data 4d Determine the slope and intercept of a linear graph 4f Understand the physical significance of area between a curve and the x-axis and measure it by counting squares as appropriate (physics questions only) 5a Use angular measures in degrees (physics questions only) 5b Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects (chemistry and physics questions only) **Working scientifically** WS 1.2 2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts

	4.4 Use prefixes and powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano). 4.5 Interconvert units. 4.6 Use an appropriate number of significant figures in calculation. **Apparatus and Techniques** AT 1 Investigate the transfer of energy from a gravitational potential energy store to a kinetic energy store AT 1, 5 Investigate thermal conductivity using rods of different materials. Required practical activity 1: investigation to determine the specific heat capacity of one or more materials. The investigation will involve linking the decrease of one energy store (or work done) to the increase in temperature and subsequent increase in thermal energy stored. AT skills covered by this practical activity: AT 1 and 5. Required practical activity 2 (physics only): investigate the effectiveness of different materials as thermal insulators and the factors that may affect	1.4 Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments 1.5 Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences. 4.5 Interconvert units. **Apparatus and Techniques** AT 6 Investigate the relationship between the resistance of a thermistor and temperature. Investigate the relationship between the resistance of an LDR and light intensity AT 7 Use of appropriate apparatus, techniques and magnification, including microscopes, to make observations of biological specimens and produce labelled scientific drawings (links to A-level AT d and e). Required practical activity 3: Use circuit diagrams to set	AT skills covered by this practical activity: AT 1.	of results and of communicating results to a range of audiences. 4.1 Use scientific vocabulary, terminology and definitions. 4.4 Students should be able to recognise expressions given in standard form.	WS 1.5 Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences WS 2.2 Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. WS 3.3 Carrying out and represent mathematical and statistical analysis. WS 3.5 Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. WS 3.7 Being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error. WS4.3 Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate.

	the thermal insulation properties of a material. AT skills covered by this practical activity: AT 1 and 5.	up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. This should include: • the length of a wire at constant temperature • combinations of resistors in series and parallel. AT skills covered by this practical activity: AT 1, 6 and 7. Required practical activity 4: use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements, including a filament lamp, a diode and a resistor at constant temperature. AT skills covered by this practical activity: AT 6 and 7			WS4.4 Use prefixes and powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano). WS 4.5 Interconvert units. WS4.6 Use an appropriate number of significant figures in calculation. **Apparatus and techniques** AT 1 Measure the effect of distractions on reaction time. AT 1, 2, 3 Investigate collisions between laboratory trollies using light gates, data loggers or ticker timers to measure and record data Required practical activity 6: investigate the relationship between force and extension for a spring. AT skills covered by this practical activity: AT 1 and 2. Required practical activity 7: investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on the acceleration

					produced by a constant force. AT skills covered by this practical activity: AT 1, 2 and 3
Prior knowledge	Y7 Energy costs Y7 Energy transfer	Y8 Potential difference and voltage Y8 Current Y9 Electromagnets	Y7 Elements Y7 particle model	Y8 Elements Y8 Periodic table	Y7 Speed Y7 Gravity Y8 Work Y9 Contact forces Y9 Pressure
GCSE assessment objectives	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures
Assessment tasks	Prior knowledge check Extended response questions on 4.1.1 Energy changes in a system, and the ways energy is stored before and after such changes.	Prior knowledge check Extended response questions on 4.2.1 Current, potential difference and resistance 4.2.2 Series and parallel circuits End of topic assessment	Prior knowledge check Extended response questions on 4.3.1 Changes of state and the particle model 4.3.2 Internal energy and energy transfers	Prior knowledge check Extended response questions on 4.4.1 Atoms and isotopes 4.4.2 Atoms and nuclear radiation 4.4.3 Hazards and uses of radioactive emissions and	Prior knowledge check Extended response questions on 4.5.1 Forces and their interactions 4.5.2 Work done and energy transfer 4.5.3 Forces and elasticity

	4.1.2 Conservation and dissipation of energy 4.1.3 National and global energy resources End of topic assessment		4.3.3 Particle model and pressure End of topic assessment	of background radiation (physics only) 4.4.4 Nuclear fission and fusion (physics only) End of topic assessment	4.5.4 Moments, levers and gears (physics only) 4.5.5 Pressure and pressure differences in fluids (physics only) 4.5.6 Forces and motion 4.5.7 Momentum (HT only) End of topic assessment

Y11 Physics	**Week 1** ◄——————————————————————————————————————► **Week 39**			
Topic	P5 Forces (continuation from Y10 SU2)	P6 Waves	P7 Magnetism and Electromagnetism	P8 Space
Key Content **Know that... (Substantive Knowledge)** **Know how…. (Disciplinary knowledge)**	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. **Maths skills** 1a Recognise and use expressions in decimal form 1c Use ratios, fractions and percentages 1d Make estimates of the results of simple calculations 2f Understand the terms mean, mode and median 3a Students should recognise and be able to use the symbol for proportionality, ∝ 3b Change the subject of an equation 3c Substitute numerical values into algebraic equations using appropriate units for physical quantities (chemistry and physics questions only) 4a Translate information between graphical and numeric form 4b Understand that y = mx + c represents a linear relationship	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. **Maths skills** MS 1c Use ratios, fractions and percentages 3b Change the subject of an equation 3c Substitute numerical values into algebraic equations using appropriate units for physical quantities (chemistry and physics questions only) 5a Use angular measures in degrees 5c Calculate areas of triangles and rectangles, surface areas and volumes of cubes	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. **Maths skills** 1c Use ratios, fractions and percentages 3b Change the subject of an equation 3c Substitute numerical values into algebraic equations using appropriate units for physical quantities (chemistry and physics questions only) **Working Scientifically** WS1.4 Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments. WS 2.2 Plan experiments or devise procedures to make observations, produce or characterise a	Questions about where we are, and where we came from, have been asked for thousands of ears. 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 electromagnetic radiation, is everywhere – what is it? And what is causing the universe to expand ever faster? **Working scientifically** 1.1 Understand how scientific methods and theories develop over time. 1.2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts 1.3 Appreciate the power and limitations of science and consider any ethical issues which may arise.

	4c Plot two variables from experimental or other data 4d Determine the slope and intercept of a linear graph 4f Understand the physical significance of area between a curve and the x-axis and measure it by counting squares as appropriate (physics questions only) 5a Use angular measures in degrees (physics questions only) 5b Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects (chemistry and physics questions only) **Working scientifically** WS 1.2 2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts WS 1.5 Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences WS 2.2 Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena. WS 3.3 Carrying out and represent mathematical and statistical analysis.	**Working scientifically** WS1.1 Understand how scientific methods and theories develop over time. WS 1.2 Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts WS 1.4 Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments. WS 1.5 Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences WS 2.2 Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena WS 2.3 Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment.	substance, test hypotheses, check data or explore phenomena	

	WS 3.5 Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. WS 3.7 Being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error. WS4.3 Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate. WS4.4 Use prefixes and powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano). WS 4.5 Interconvert units. WS4.6 Use an appropriate number of significant figures in calculation. **Apparatus and techniques** AT 1 Measure the effect of distractions on reaction time. AT 1, 2, 3 Investigate collisions between laboratory trollies using light gates, data loggers or ticker timers to measure and record data	2.4 Carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. 2.6 Make and record observations and measurements using a range of apparatus and methods. 2.7 Evaluate methods and suggest possible improvements and further investigations. 3.1 Presenting observations and other data using appropriate methods 3.5 Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. **Apparatus and techniques** AT 1 Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, volume and temperature. Use of such measurements to determine densities of solid and liquid objects (links to A-level AT a and b). AT 4 Making observations of waves in fluids and solids to identify the suitability of apparatus to measure		

	Required practical activity 6: investigate the relationship between force and extension for a spring. AT skills covered by this practical activity: AT 1 and 2. Required practical activity 7: investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on the acceleration produced by a constant force. AT skills covered by this practical activity: AT 1, 2 and 3	speed/frequency/wavelength. Making observations of the effects of the interaction of electromagnetic waves with matter (links to A-level AT i and j). AT 4, 8 Investigate the magnification produced by a range of convex lenses. Required practical activity 8: make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid and take appropriate measurements. AT skills covered by this practical activity: AT 4. Required practical activity 9 (physics only): investigate the reflection of light by different types of surface and the refraction of light by different substances. AT skills covered by this practical activity: AT 4 and 8. Required practical activity 10: investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface. AT skills covered by this practical activity: AT 1 and 4.		
Prior knowledge	Y7 Speed Y7 Gravity Y8 Work	Y8 Sound Y8 Light Y8 Heating and cooling	Y8 Potential difference and voltage Y8 Current Y9 Magnetism	Y8 Universe

	Y9 Contact forces Y9 Pressure	Y9 Wave effects Y9 Wave properties	Y9 Electromagnets	
GCSE assessment objectives	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures	AO1: Demonstrate knowledge and understanding of: • scientific ideas • scientific techniques and procedures. AO2: Apply knowledge and understanding of: • scientific ideas • scientific enquiry • techniques and procedures. AO3: Analyse information and ideas to • interpret and evaluate • make judgements and draw conclusions • develop and improve experimental procedures
Assessment tasks	Prior knowledge check Extended response questions on 4.5.1 Forces and their interactions 4.5.2 Work done and energy transfer 4.5.3 Forces and elasticity 4.5.4 Moments, levers and gears (physics only) 4.5.5 Pressure and pressure differences in fluids (physics only) 4.5.6 Forces and motion 4.5.7 Momentum (HT only) End of topic assessment	Prior knowledge check Extended response questions on 4.6.1 Waves in air, fluids and solids 4.6.2 Electromagnetic waves 4.6.3 Black body radiation (physics only) End of topic assessment	Prior knowledge check Extended response questions on 4.7.1 Permanent and induced magnetism, magnetic forces and fields 4.7.2 The motor effect 4.7.3 Induced potential, transformers and the National Grid (physics only) (HT only) End of topic assessment	Prior knowledge check Extended response questions on 4.8.1 Solar system; stability of orbital motions; satellites (physics only) 4.8.2 Red-shift (physics only) End of topic assessment