

Term	INTENT	IMPLEMENTATION	IMPACT
GCSE OCR A Gateway Science Suite	Substantive Knowledge This is the specific, factual content for the topic, which should be connected into a careful sequence of learning.	Disciplinary Knowledge (Skills) This is the action taken within a particular topic in order to gain substantive knowledge.	Assessment opportunities What assessments will be used to measure student progress? Evidence of how well students have learned the intended content.
Autumn Term 1A Year 11	Intent Why is this taught now? P5.3 Having studied the electromagnetic spectrum learners now go on to look at the interactions of waves with materials, this will include absorption, refraction and reflection. Learners will also be expected to draw ray diagrams to illustrate the refraction of rays through lenses. Learners will already be familiar with the properties and behaviour of light. They are expected to have an understanding of behaviour such as reflection, refraction, absorption and scattering. Learners should know that colours are produced by light at different frequencies. P6.1 Having considered the general characteristics of waves and particles, we now move on to look at radioactive decay which combines these two ideas. The idea of isotopes is introduced, leading into looking at the different types of emissions from atoms. Learners should have prior understanding of the atomic model, chemical symbols and formulae. An understanding of radioactivity is	P5.3a Recall that different substances may absorb, transmit, refract, or reflect electromagnetic waves in ways that vary with wavelength. P5.3b Explain how some effects are related to differences in the velocity of electromagnetic waves in different substances. P5.3c Use ray diagrams to illustrate reflection, refraction, and the similarities and differences between convex and concave lenses (qualitative only). P5.3d Construct 2D ray diagrams to illustrate reflection and refraction (qualitative – equations not needed). M5a Use angular measures in degrees. M5b Visualise and represent 2D and 3D forms including 2D representations of 3D objects. P5.3e Explain how colour is related to differential absorption, transmission, and reflection. WS1.1b Use models to solve problems, make predictions, and develop scientific explanations and understanding of familiar and unfamiliar facts. WS1.2c Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS1.3a Present observations and other data using appropriate methods. WS1.3e Interpret observations and other data. WS1.3h Identify potential sources of random and systematic error.	Classwork and homework tasks. A formal unit test will be sat by all students approximately three weeks before planned report dates.

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	not expected and should be taught as new content.	WS2a Carry out experiments. WS2b Make and record observations and measurements using a range of apparatus and methods. WS2c Present observations using appropriate methods. P6.1a Recall that atomic nuclei are composed of both protons and neutrons, and that the nucleus of each element has a characteristic positive charge. P6.1b Recall that atoms of the same elements can differ in nuclear mass by having different numbers of neutrons. P6.1c Use the conventional representation for nuclei to relate the differences between isotopes. M3d Solve simple algebraic equations. P6.1d Recall that some nuclei are unstable and may emit alpha particles, beta particles, or neutrons, and electromagnetic radiation as gamma rays. P6.1l Recall the differences in the penetration properties of alpha particles, beta particles and gamma rays. P6.1e Relate alpha, beta, and gamma emissions to possible changes in the mass or the charge of the nucleus, or both. P6.1f Use names and symbols of common nuclei and particles to write balanced equations that represent radioactive decay. P6.1g Balance equations representing the emission of alpha-, beta-, or gamma-radiation in terms of the masses and charges of the atoms involved. M1b Recognise expressions in standard form. M1c Use ratios, fractions, and percentages. M3c Substitute numerical values into algebraic equations using appropriate units for physical quantities. WS1.1a Understand how scientific methods and theories develop over time. WS1.1b Use models to solve problems, make predictions, and develop scientific explanations and understanding of familiar and unfamiliar facts. WS1.2a Use scientific theories and explanations to develop hypotheses.	
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		WS1.2c Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS1.2d Recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative. WS1.3a Present observations and other data using appropriate methods. WS1.3f Present reasoned explanations. WS1.4a Use scientific vocabulary, terminology, and definitions.	
Autumn Term 1B Year 11	Intent Why is this taught now?	P6.1j Explain the concept of half-life and how this is related to the random nature of radioactive decay.	Classwork and homework tasks. A formal unit test will be sat by all students approximately three weeks before planned report dates. This could include a formal trial examination if sat this term.
	P6.1 Continuing the work started in term 1A. P6.2 We now address the hazards and applications of radioactive decay. The processes of fission and fusion as a source of energy are also considered. Learners may have prior understanding of the term radioactivity from the previous sub topic and may be familiar with some uses, but will not have covered this content prior to this topic. P7.1 We now move on to consider how energy can be stored and transferred. This topic acts to consolidate the ideas of energy that have been covered in previous topics as it is a fundamental concept that underpins many of the ways in which matter interacts. Learners may have prior knowledge of energy listed as nine types, as this is the teaching approach often taken at Key Stage 2 and Key Stage 3 to increase accessibility to an abstract concept. Learners may find it difficult to move away from this idea but need to be able to	P6.1k Calculate the net decline, expressed as a ratio, during radioactive emission after a given (integral) number of half-lives. M1c Use ratios, fractions, and percentages. M2g Use a scatter diagram to identify a correlation between two variables. M3d Solve simple algebraic equations. P6.1h Recall that in each atom its electrons are arranged at different distances from the nucleus, that such arrangements may change with absorption or emission of electromagnetic radiation, and that atoms can become ions by loss of outer electrons. P6.1i Recall that changes in atoms and nuclei can also generate and absorb radiation over a wide frequency range. WS1.1b Use models to solve problems, make predictions, and develop scientific explanations and understanding of familiar and unfamiliar facts. WS1.3a Present observations and other data using appropriate methods. WS1.3b Translate data from one form to another. WS1.3c Carry out and represent mathematical and statistical analysis. WS1.3d Represent distributions of results and make estimations of uncertainty. WS1.3e Interpret observations and other data. WS1.3f Present reasoned explanations.	

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	approach systems in terms of energy transfers and stores. They will have an understanding that energy can be transferred in processes such as changing motion, burning fuels and in electrical circuits. Learners should also be aware of the idea of conservation of energy and that it has a quantity that can be calculated.	WS1.4a Use scientific vocabulary, terminology, and definitions. WS2a Carry out experiments. P6.2a Recall the differences between contamination and irradiation effects and compare the hazards associated with them. P6.2b Explain why the hazards associated with radioactive material differ according to the half-life involved. P6.2c Describe the different uses of nuclear radiation for exploration of internal organs, and for control or destruction of unwanted tissue. M1a Recognise and use expressions in decimal form. M1c Use ratios, fractions, and percentages. P6.2d Recall that some nuclei are unstable and may split, and relate such effects to radiation which might emerge, to transfer of energy to other particles, and to the possibility of chain reactions. M3d Solve simple algebraic equations. P6.2e Describe the process of nuclear fusion. M3c Substitute numerical values into algebraic equations using appropriate units for physical quantities. WS1.1c Understand the power and limitations of science. WS1.1d Discuss ethical issues arising from developments in science. WS1.1e Explain everyday and technological applications of science. WS1.1f Evaluate personal, social, economic, and environmental implications of everyday and technological applications of science. WS1.1h Evaluate risks both in practical science and the wider societal context. WS1.3f Present reasoned explanations. P7.1a Describe, for situations where there are energy transfers in a system, that there is no net change to the total energy of a closed system (qualitative only).	
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		P7.1b Describe all the changes involved in the way energy is stored when a system changes for common situations. P7.1c Describe the changes in energy involved when a system is changed by heating (in terms of temperature change and specific heat capacity), by work done by forces, and by work done when a current flows. P7.1d Make calculations of the energy changes associated with changes in a system, recalling or selecting the relevant equations for mechanical, electrical, and thermal processes; thereby express in quantitative form and on a common scale the overall redistribution of energy in the system. P7.1e Calculate the amounts of energy associated with a moving body, a stretched spring, and an object raised above ground level. M2g Use a scatter diagram to identify a correlation between two variables. PM2.1iv Recall and apply: kinetic energy (J) = $0.5 \times \text{mass (kg)} \times (\text{speed (m/s)})^2$ WS1.1b Use models to solve problems, make predictions, and develop scientific explanations and understanding of familiar and unfamiliar facts. WS1.2c Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS1.3a Present observations and other data using appropriate methods. WS1.3e Interpret observations and other data. WS1.4a Use scientific vocabulary, terminology, and definitions.	
Spring Term 2A Year 11	Intent Why is this taught now?	P7.1b Describe all the changes involved in the way energy is stored when a system changes for common situations. P7.1c Describe the changes in energy involved when a system is changed by heating (in terms of temperature change and specific heat capacity), by work done by forces, and by work done when a current flows.	Classwork and homework tasks. A formal unit test will be sat by all students approximately three weeks before planned report dates. This could include a formal trial examination if sat this term.
	P7.1 Continuing the work started in term 1B. P7.2 This considers the idea of conservation and dissipation of energy in systems and how this		

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	leads to the efficiency. Ways of reducing unwanted energy transfers and thereby increasing efficiency will be explored. Learners should be aware of the transfer of energy into useful and waste energies. They will have an understanding of power and how domestic appliances can be compared. Learners will have knowledge of insulators and how energy transfer is influenced by temperature. They should have an awareness of ways to reduce heat loss in the home.	P7.1d Make calculations of the energy changes associated with changes in a system, recalling or selecting the relevant equations for mechanical, electrical, and thermal processes; thereby express in quantitative form and on a common scale the overall redistribution of energy in the system. P7.1e Calculate the amounts of energy associated with a moving body, a stretched spring, and an object raised above ground level. PM2.1iv Recall and apply: kinetic energy $(J) = 0.5 \times \text{mass (kg)} \times (\text{speed (m/s)})^2$. PM2.2iii Recall and apply: work done $(J) = \text{force (N)} \times \text{distance (m)}$ (along the line of action of the force). PM2.3ii Apply: energy transferred in stretching $(J) = 0.5 \times \text{spring constant (N/m)} \times (\text{extension (m)})^2$ WS1.2b Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data, or explore phenomena. WS1.2c Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS1.3g Evaluate data in terms of accuracy, precision, repeatability, and reproducibility. WS1.3e Interpret observations and other data. WS1.3h Identify potential sources of random and systematic error. WS1.3i Communicate the scientific rationale for investigations, methods used, findings, and reasoned conclusions. P7.1b Describe all the changes involved in the way energy is stored when a system changes for common situations. P7.2b Describe how, in different domestic devices, energy is transferred from batteries or the alternating current from the mains. P7.2c Describe, with examples, the relationship between the power ratings for domestic electrical appliances and how this is linked to the changes in stored energy when they are in use.	
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		P7.1c Describe the changes in energy involved when a system is changed by heating (in terms of temperature change and specific heat capacity), by work done by forces, and by work done when a current flows. P7.1d Make calculations of the energy changes associated with changes in a system, recalling or selecting the relevant equations for mechanical, electrical, and thermal processes; thereby express in quantitative form and on a common scale the overall redistribution of energy in the system. M2g Use a scatter diagram to identify a correlation between two variables. M3d Solve simple algebraic equations. P7.2a Describe, with examples, the process by which energy is dissipated, so that it is stored in less useful ways. M3c Substitute numerical values into algebraic equations using appropriate units for physical quantities. P7.2f Explain ways of reducing unwanted energy transfer. P7.2g Describe how the rate of cooling of a building is affected by the thickness and thermal conductivity of its walls (qualitative only). M1d Make estimates of the results of simple calculations, without using a calculator. P7.2d Calculate energy efficiency for any energy transfer. P7.2e Describe ways to increase efficiency. H PM7.2i Recall and apply: $\text{efficiency} = \frac{\text{useful output energy transfer (J)}}{\text{input energy transfer (J)}}$ WS1.1e Explain everyday and technological applications of science. WS1.1f Evaluate personal, social, economic, and environmental implications of everyday and technological applications of science. WS1.2a Use scientific theories and explanations to develop hypotheses. WS1.2b Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data, or explore phenomena.	
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		WS1.2c Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. WS1.3a Present observations and other data using appropriate methods. WS1.3c Carry out and represent mathematical and statistical analysis. WS1.3d Represent distributions of results and make estimations of uncertainty. WS1.3e Interpret observations and other data. WS1.3f Present reasoned explanations. WS1.3g Evaluate data in terms of accuracy, precision, repeatability, and reproducibility. WS1.3h Identify potential sources of random and systematic error. WS1.4e Interconvert units. WS2a Carry out experiments. WS2b Make and record observations and measurements using a range of apparatus and methods. WS2c Present observations using appropriate methods. WS2d Communicate the scientific rationale for investigations, methods used, findings, and reasoned conclusions.	
Spring Term 2B Year 11	Intent Why is this taught now?	P8.1a Recall typical speeds encountered in everyday experience for wind and sound, and for walking, running, cycling, and other transportation systems. P8.1b Estimate the magnitudes of everyday accelerations. P8.1c Make calculations using ratios and proportional reasoning to convert units and to compute rates. P2.1a Describe how to measure distance and time in a range of scenarios. P8.1d Explain methods of measuring human reaction times and recall typical results. P8.1e Explain the factors which affect the distance required for road transport vehicles to come to rest in emergencies and the implications for safety.	Classwork and homework tasks. A formal unit test will be sat by all students approximately three weeks before planned report dates.
	P8.1 Learners will use their knowledge of forces and motion to develop their ideas about how objects are affected by external factors. They will develop a better understanding of these external factors to be able to understand how the design of objects such as cars may be modified to operate more safely. Learners should be familiar with how forces affect motion of objects. They will also need to have a good understanding of momentum from P2.2. Learners may already have some		

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	knowledge of how vehicles are adapted to increase safety. P8.2 We are reliant on electricity for everyday life and this topic explores the production of electricity. Consideration will be given to the use of non-renewable and renewable sources and the problems that are faced in the efficient transportation of electricity to homes and businesses. Safe use of electricity in the home is also covered in this topic. It may be an opportunity to revisit power and efficiency. Learners should already be familiar with renewable and non-renewable energy sources. Learners are expected to have a basic understanding of how power stations work and the cost of electricity in the home. They may have some idea of electrical safety features in the home. Links to Sustainability Compare renewable and non-renewable generation methods, carbon emissions, and environmental impacts. Discuss electricity demand in homes and how reducing unnecessary electrical consumption lowers carbon emissions.	P8.1f Estimate how the distances required for road vehicles to stop in an emergency vary over a range of typical speeds. M1d Make estimates of the results of simple calculations, without using a calculator. M2h Make order-of-magnitude calculations. M3b Change the subject of an equation. M3c Substitute numerical values into algebraic equations using appropriate units for physical quantities. P8.1g Explain the dangers caused by large decelerations. P8.1h Estimate the forces involved in typical situations on a public road. P8.1i Estimate, for everyday road transport, the speed, accelerations, and forces involved in large accelerations. M1a Recognise and use expressions in decimal form. M2a Use an appropriate number of significant figures. M2b Find arithmetic means. M1c Use ratios, fractions, and percentages. WS1.1e Explain everyday and technological applications of science. WS1.1f Evaluate personal, social, economic, and environmental implications of everyday and technological applications of science. WS1.1h Evaluate risks in both practical science and the wider societal context. M1c Use ratios, fractions, and percentages. WS1.2b Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data, or explore phenomena. WS1.2d Recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative. WS1.2e Evaluate methods and suggest possible improvements and further investigations. WS1.3c Carry out and represent mathematical and statistical analysis. WS1.3d Represent distributions of results and make estimations of uncertainty. WS1.3e Interpret observations and other data.	
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		WS1.3g Evaluate data in terms of accuracy, precision, repeatability, and reproducibility. WS1.4b Recognise the importance of scientific quantities and understand how they are determined. WS2a Carry out experiments. WS2b Make and record observations and measurements using a range of apparatus and methods. WS2c Present observations using appropriate methods. P8.2a Describe the main energy sources available for use on Earth, compare the ways in which they are used, and distinguish between renewable and non- renewable sources. M2c Construct and interpret frequency tables and diagrams, bar charts, and histograms. P8.2b Explain patterns and trends in the use of energy resources. M4a Translate information between graphical and numeric form. P8.2c Recall that, in the National Grid, electrical power is transferred at high voltages from power stations, and then transferred at lower voltages in each locality for domestic use. P8.2d Recall that step-up and step-down transformers are used to change the potential difference as power is transferred from power stations. P8.2e Explain how the National Grid is an efficient way to transfer energy. P8.2f Link the potential differences and numbers of turns of a transformer to the power transfer involved; relate this to the advantages of power transmission at high voltages. PM8.2i Apply: potential difference across primary coil (V) $\times$ current in primary coil (A) = potential difference across secondary coil (V) $\times$ current in secondary coil (A). P8.2g Recall that the domestic supply in the UK is alternating current at 50 Hz and about 230 V. P8.2h Explain the difference between direct and alternating voltage.	
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		P8.2i Recall the differences in function between the live, neutral, and earth mains wires, and the potential differences between these wires. P8.2j Explain that a live wire may be dangerous even when a switch in a mains circuit is open, and explain the dangers of providing any connection between the live wire and earth. WS1.1c Understand the power and limitations of science. WS1.1d Discuss ethical issues arising from developments in science. WS1.1e Explain everyday and technological applications of science. WS1.1f Evaluate personal, social, economic, and environmental implications of everyday and technological applications of science. WS1.1g Make decisions based on the evaluation of evidence and arguments. WS1.1h Evaluate risks both in practical science and the wider societal context. WS1.3b Translate data from one form to another. WS1.3e Interpret observations and other data. WS1.4a Use scientific vocabulary, terminology, and definitions. WS1.4b Recognise the importance of scientific quantities and understand how they are determined. M3d Solve simple algebraic equations.	
Summer Term 3A Year 11	Intent Why is this taught now?	8.3a Explain the red-shift of light from galaxies which are receding (qualitative only) and that the change with distance of each galaxy's speed is evidence of an expanding universe. P8.3b Explain how red-shift and other evidence can be linked to the Big Bang model. P8.3c Recall that the Sun was formed from dust and gas drawn together by gravity and explain how this caused fusion reactions, leading to equilibrium between gravitational collapse and expansion due to the fusion energy. P8.3e Recall the main features of our Solar System, including the similarities and distinctions between the planets, their moons, and artificial satellites.	Classwork and homework tasks. A formal unit test will be sat by all students approximately three weeks before planned report dates.
	P8.3 In this astrophysics topic learners will look in more detail at how we can investigate the characteristics of planets. To begin with learners will investigate bodies that are close to our own planet and consider factors that affect natural and artificial satellites. The topic then moves onto considering bodies within the universe, and will apply their knowledge of fusion processes to understand the life cycle of		

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	a star and waves to consider black body radiation. The Big Bang theory will be studied and the evidence that supports it as a scientific theory. Learners should already be familiar with the bodies within our own solar system and the behaviour of satellites. They may have a basic understanding of the Big Bang theory and that distances to other celestial bodies is large.	M1b Recognise expressions in standard form. M1c Use ratios, fractions, and percentages. M5b Visualise and represent 2D and 3D forms including 2D representations of 3D objects. P8.3f Explain how, for the circular orbits, the force of gravity can lead to changing velocity of a planet but unchanged speed (qualitative only). P8.3g Explain how, for a stable orbit, the radius must change if the speed of a planet changes (qualitative only). M3d Solve simple algebraic equations. P8.3d Explain that all bodies emit radiation, and that the intensity and wavelength distribution of any emission depends on their temperatures. P8.3h Explain how the temperature of a body is related to the balance between incoming radiation absorbed and radiation emitted; illustrate this balance using everyday examples and the example of the factors which determine the temperature of the Earth. P8.3i Explain, in qualitative terms, how the differences in velocity, absorption, and reflection between different types of waves in solids and liquids can be used both for detection and for exploration of structures which are hidden from direct observation, notably in the Earth's core and in deep water. WS1.1a Understand how scientific methods and theories develop over time. WS1.1b Use models to solve problems, make predictions, and develop scientific explanations and understanding of familiar and unfamiliar facts. WS1.1c Understand the power and limitations of science. WS1.1e Explain everyday and technological applications of science. WS1.1f Evaluate personal, social, economic and environmental implications of everyday and technological applications of science. WS1.1g Make decisions based on the evaluation of evidence and arguments.	
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		WS1.1h Evaluate risks both in practical science and the wider societal context. WS1.3b Translating data from one form to another. WS1.4a Use scientific vocabulary, terminology, and definitions.	
Summer Term 3B Year 11	<u>Intent</u> Why is this taught now?		