Year 11 Separate Science Curriculum – 2024-2025						
	Autumn Term		Spring Term		Summer Term	
	1	2	1	2	1	2
Key Concepts	Plants Heat energy changes in chemical reactions, hydrocarbon fuels Magnetism and Electromagnetic induction	Plants, Animal coordination and control, Fuels, separate science organic chemistry, Energy and work done, particle model and forces and matter	Qualitative chemistry Fuels, separate science organic chemistry, particle model and forces and matter, bulk and surface properties of matter.	Revision	Exams	Exams

Knowledge & Understanding (National Curriculum) Skills are across the whole year.	Items highlighted in bold are Higher tier only. In Biology students will know and understand how to: During the Plants topic students study: ● Describe photosynthetic organisms as the main producers of food and therefore biomass ● Describe photosynthesis in plants and algae as an endothermic reaction that uses light energy to react carbon dioxide and water to produce glucose and oxygen ● Explain the effect of temperature, light intensity and carbon dioxide concentration as limiting factors on the rate of photosynthesis ● **Explain the interactions of temperature, light intensity and carbon dioxide concentration in limiting the rate of photosynthesis** ● Core Practical: Investigate the effect of light intensity on the rate of photosynthesis ● **Explain how the rate of photosynthesis is directly proportional to light intensity and inversely proportional to the distance from a light source, including the use of the inverse square law calculation** ● Explain how the structure of the root hair cells is adapted to absorb water and mineral ions 6.8 Explain how the structures of the xylem and phloem are adapted to their function in the plant, including: a) lignified dead cells in xylem transporting water and minerals through the plant b) living cells in phloem using energy to transport sucrose around the plant ● Explain how water and mineral ions are transported through the plant by transpiration, including the structure and function of the stomata ● Describe how sucrose is transported around the plant by translocation ● Explain how the structure of a leaf is adapted for photosynthesis and gas exchange ● Explain the effect of environmental factors on the rate of water uptake by a plant, to include light intensity, air movement and temperature ● Demonstrate an understanding of rate calculations for transpiration ● Explain how plants are adapted to survive in extreme environments including the effect of leaf size and shape, the cuticle and stomata 2d 5c 6.15B Explain how plant hormones control and coordinate plant growth and development, including the role of auxins in phototropisms and gravitropisms ● **Describe the commercial uses of auxins, gibberellins and ethene in plants, including: a) auxins in weedkillers and rooting powders b) gibberellins in germination, fruit and flower formation and the production of seedless fruit c) ethene in fruit ripening** Animal coordination, control and homeostasis ● Describe where hormones are produced and how they are transported from endocrine glands to their target organs ● **Explain that adrenalin is produced by the adrenal glands to prepare the body for fight or flight.,**

	• **Explain how thyroxine controls metabolic rate as an example of negative feedback.** • Describe the stages of the menstrual cycle including the roles of the hormones oestrogen and progesterone. • **Explain the interactions of oestrogen, progesterone, FSH and LH in the control of the menstrual cycle, including the repair and maintenance of the uterus wall, ovulation and menstruation.** • Explain how hormonal contraception influences the menstrual cycle and prevents pregnancy. • Evaluate hormonal and barrier methods of contraception. • **Explain the use of hormones in Assisted Reproductive Technology (ART) and clomifene therapy** • Explain the importance of maintaining a constant internal environment in response to internal and external change • Explain the importance of homeostasis, including: a) thermoregulation, b) osmoregulation • Explain the thermoregulation takes place, with reference to the function of the skin. • Explain how thermoregulation takes place, with reference to shivering, **vasoconstriction, vasodilation** • Explain how the hormone insulin controls blood glucose concentration • **Explain how blood glucose concentration is regulated by glucagon** • Explain the cause of type 1 diabetes and how it is controlled • Explain the cause of type 2 diabetes and how it is controlled • Evaluate the correlation between BMI and type 2 diabetes including waist:hip ration calculations and BMI. • Describe the structure of the urinary system • Explain how the structure of the nephron is related to its function in filtering the blood and forming urine including: a) filtration in the glomerulus and Bowman's capsule, b) selective reabsorption of glucose, c) reabsorption of water • **Explain the effect of ADH on the permeability of the collecting duct in regulating the water content of the blood** • Describe the treatments for kidney failure, including kidney dialysis and organ donation • State that urea is produced from the breakdown of excess amino acids in the liver In Chemistry students will know and understand how to: Heat energy changes in chemical reactions • Recall that changes in heat energy accompany the following changes: a salts dissolving in water b neutralisation reactions c displacement reactions d precipitation reactions and that, when these reactions take place in solution, temperature changes can be measured to reflect the heat changes

	• Describe an exothermic change or reaction as one in which heat energy is given out • Describe an endothermic change or reaction as one in which heat energy is taken in • Recall that the breaking of bonds is endothermic and the making of bonds is exothermic • Recall that the overall heat energy change for a reaction is: a) exothermic if more heat energy is released in forming bonds in the products than is required in breaking bonds in the reactants b) endothermic if less heat energy is released in forming bonds in the products than is required in breaking bonds in the reactants • **Calculate the energy change in a reaction given the energies of bonds (in kJ/mol)** • Explain the term activation energy • Draw and label reaction profiles for endothermic and exothermic reactions, identifying activation energy Fuels • Recall that hydrocarbons are compounds that contain carbon and hydrogen only • Describe crude oil as: "a complex mixture of hydrocarbons, containing molecules in which carbon atoms are in chains or rings (names, formulae and structure of specific ring molecules not required), an important source of useful substances (fuels and feedstock for the petrochemical industry), a finite resource • Describe and explain the separation of crude oil into simpler, more useful mixtures by the process of fractional distillation. • Recall the names and uses of the following fractions: a) gases- used in domestic heating and cooking, b) petrol- used as fuel for cars, c) kerosene, used as fuel for aircraft, d) diesel oil- used as fuel for some cars and trains, e) fuel oil- used as fuel for large ships and in some power stations, f) bitumen- used to surface roads and roofs • Explain how hydrocarbons in different fractions differ from each other in: a) the number of carbon atoms their molecules contain, b) boiling points, c) ease of ignition, d) viscosity and are mostly members of the alkane homologous series • Explain an homologous series as a series of compounds which a) have the same general formula, b) differ by CH_2 in molecular formule from neighbouring compounds; c) show a gradual variation in physical properties, as exemplified by their boiling points; d) have similar chemical properties. • Describe the complete combustion of hydrocarbon fuels as a reaction in which: a) carbon dioxide and water are produced; b) energy is given out • Explain why the incomplete combustion of hydrocarbons can produce carbon and carbon monoxide • Explain how carbon monoxide behaves as a toxic gas • Describe the problems caused by incomplete combustion producing carbon monoxide and soot in appliances that use carbon compounds as fuels

	• Explain how impurities in some hydrocarbon fuels result in the production of sulphur dioxide • Explain some problems associated with acid rain caused when sulphur dioxide dissolves in rainwater • Explain why, when fuels are burned in engines, oxygen and nitrogen can react together at high temperatures to produce oxides of nitrogen, which are pollutants • Evaluate the advantages and disadvantages of using hydrogen rather than petrol, as a fuel in cars • Recall that petrol, kerosene and diesel oil are non-renewable fossil fuels obtained from crude oil and methane is non-renewable fossil fuel found in natural gas • Explain how cracking involves the breaking down of larger, saturated hydrocarbon molecules (alkanes) into smaller, more useful ones, some of which are unsaturated (alkenes) • Explain why cracking is necessary Hydrocarbons (separate science only) • Recall the formulae of molecules of the alkanes, methane, ethane, propane and butane, and draw the structures of these molecules, showing all covalent bonds • Explain why the alkanes are saturated hydrocarbons • Recall the formulae of molecules of the alkenes, ethene, propene, butene, and draw the structures of these molecules, showing all covalent bonds (but-1-ene and but-2-ene only) • Explain why the alkenes are unsaturated hydrocarbons, describing that their molecules contain the functional group C=C • Recall the addition reaction of ethene with bromine, showing the structures of reactants and products, and extend this to other alkenes 5b 9. Explain how bromine water is used to distinguish between alkanes and alkenes • Describe how the complete combustion of alkanes and alkenes involves the oxidation of the hydrocarbons to produce carbon dioxide and water Separate chemistry 2- Qualitative analysis: tests for ion • Explain why the test for any ion must be unique • Describe flame tests to identify ions • Describe tests to identify ions in solids or solutions as appropriate • Describe the chemical test for ammonia

	• Describe tests to identify ions in solids or solutions as appropriate including- carbonate ions using dilute acid and identifying the carbon dioxide evolved, sulfate ions, using dilute hydrochloric acid and barium chloride solution, halogen ions using dilute nitric acid and silver nitrate solution. • Core practical- Identify the ions in unknown salts using the tests for specified cations and anions • Identify the ions in unknown salts, using results of tests. • Describe that instrumental methods of analysis are available and that these may improve sensitivity, accuracy and speed of tests • Evaluate data from a flame photometer: a) to determine the concentration of ions in dilute solution using a calibration curve; b) to identify metal ions by comparing the data with reference data Hydrocarbons • Recall the formulae of molecules of the alkanes, methane, ethane, propane and butane, and draw the structures of these molecules, showing all covalent bonds • Explain why the alkanes are saturated hydrocarbons • Recall the formulae of molecules of the alkenes, ethene, propene, butene and draw the structures of these molecules, showing all covalent bonds (but-1-ene and but-2-ene only) • Explain why the alkenes are unsaturated hydrocarbons, describing that their molecules contain the functional group C=C • Recall the addition reaction of ethene with bromine, showing the structures of reactants and products, and extend this to other alkenes • Describe how the complete combustion of alkanes and alkenes involves the oxidation of the hydrocarbons to produce carbon dioxide and water Polymers • Recall that a polymer is a substance of high average relative molecular mass made up of small repeating units • Describe: a) how ethene molecules can combine together in a polymerisation reaction b) that the addition polymer formed is called poly(ethene) • Describe how other addition polymers can be made by combined together other monomer molecules containing C=C, to include poly(propene), poly(chloroethene) (PVC) and poly(tetrafluoroethene) (PTFE) • Describe the structure of a monomer from the structure of an addition polymer and vice versa • Explain how the uses of polymers are related to their properties and vice versa: including poly(ethene), poly(propene), poly(chloroethene) (PVC) and poly(tetrafluoroethene) (PTFE)

	• Explain a) why polyesters are condensation polymers b) how a polyester is formed when a monomer molecule containing two carboxylic acid groups is reacted with a monomer molecule containing two alcohol groups; c) how a molecule of water is formed each time an ester link is formed • Describe some problems associated with polymers • Evaluate the advantages and disadvantages of recycling polymers, including economic availability of starting materials and environmental impact • Recall that DNA is a polymer made from four different monomers called nucleotides, starch is a polymer based on sugars, proteins are polymers based on amino acids Alcohols and carboxylic acids • Recall the formulae of molecules of the alcohols, methanol, ethanol, propan-1-ol and butan-1-ol, and draw the structures of these molecules, showing all covalent bonds • Recall that the functional group in alcohols is -OH and that alcohols can be dehydrated to form alkenes • Core Practical- Investigate the temperature rise produced in a known mass of water by the combustion of the alcohols ethanol, propanol, butanol and pentanol • Recall the formulae of molecules of the carboxylic acids, methanoic, ethanoic, propanoic and butanoic acids, and draw the structures of these molecules, showing all covalent bonds • Recall that the functional group in carboxylic acids is -COOH and that solutions of carboxylic acids have typical acidic properties • Recall that ethanol can be oxidised to produce ethanoic acid and extend this to other alcohols • Recall members of a given homologous series have similar reactions because their molecules contain the same functional group and use this to predict the products of other members of this series • Describe the production of ethanol by fermentation of carbohydrates in aqueous solution, using yeast to provide enzymes • Explain how to obtain a concentrated solution of ethanol by fractional distillation of the fermentation mixture Bulk and surface properties of matter • Compare the size of nanoparticles with the sizes of atoms and molecules • Describe how the properties of nanoparticulate materials are related to their uses including surface area to volume ratio of the particles they contain, including sunscreens • Explain the possible risks associated with some nanoparticulate materials • Compare, using data, the physical properties of glass and clay ceramics, polymers, composites and metals

	• Explain why the properties of a material make it suitable for a given use and use data to select materials appropriate for specific uses In Physics students will study: Particle model: • Use a simple kinetic theory model to explain the different states of matter in terms of the movement and arrangement of particles • Recall and use the equation for calculating density • Core Practical: Investigate the densities of solid and liquids • Explain the differences in density between the different states of matter in terms of the arrangements of the atoms or molecules • Describe that when substances change state mass is conserved and that these physical changes differ from some chemical changes because the material recovers its original properties if the change is reversed • Explain how heating a system will change the energy stored within the system and raise its temperature or produce changes of state • Define the terms specific heat capacity and specific latent heat and explain the differences between them • Use the equation to calculate change in thermal energy when a substance is heated up (Specific heat capacity) • Use the equation to calculate change in thermal energy when a substance changes state (latent heat) • Explain ways of reducing unwanted energy transfer through thermal insulation • Core Practical: Investigate the properties of water by determining the specific heat capacity of water and obtaining a temperature-time graph for melting ice • Explain the pressure of a gas in terms of the motion of its particles • Explain the effect of changing the temperature of a gas on the velocity of its particles and hence on the pressure produced by a fixed mass of gas at constant volume (qualitative only) • Describe the term absolute zero, -273°C, in terms of the lack of movement of particles • Convert between the kelvin and Celsius scales • Explain that gases can be compressed or expanded by pressure changes • Explain that the pressure of a gas produces a net force at right angles to any surface • Explain the effect of changing the volume of a gas on the rate at which its particles collide with the walls of its container and hence on the pressure produced by a fixed mass of gas at constant temperature • Use the equation derived by Boyle's law to calculate pressure or volume for gassed of fixed mass and constant temperature • Explain why doing work on a gas can increase its temperature, including a bicycle pump Forces and their effects

	• Explain, using springs and other elastic objects, that stretching, bending or compressing an object requires more than one force • Describe the difference between elastic and inelastic distortion • Recall and use the equation for linear elastic distortion including calculation of the spring constant. • Use the equation to calculate the work done in stretching a spring • Describe the difference between linear and non-linear relationships between force and extension • Core Practical- Investigate the extension and work done when applying forces to a spring • Explain why atmospheric pressure varies with height above the Earth's surface with reference to a simple model of the Earth's atmosphere • Describe the pressure in a fluid as being due to the fluid and atmospheric pressure • Recall that the pressure in fluids causes a force normal to any surface • Explain how pressure is related to force and area • Recall and use the equation: Pressure = Force/ Area • Describe how pressure in fluids increases with depth and density • Explain why the pressure in liquids varies with density and depth • Use an equation to calculate the magnitude of pressure in liquids and calculate the difference in pressure at different heights in a liquid. • Explain why an object in a fluid is subject to an upwards force and relate this to examples including objects that are fully immersed in a fluid (liquid or gas) or partially immersed in a liquid • Recall that the upthrust is equal to the weight of fluid displaced • Explain how factors influence whether or not an object will float or sink Energy and Forces • Describe the changes involved in the way energy is stored when systems change. • Draw and interpret diagrams to represent energy transfers. • Explain that where there are energy transfers in a closed system there is no net change to the total energy in that system. • Identify the different ways that the energy of a system can be changed through work done by forces, in electrical equipment and in heating. • Describe how to measure the work done by a force and understand that energy transferred (joule, J) is equal to work done (joule, J). • Recall the equation: work done (joule, J) = force (newton, N) × distance moved in the direction of the force (metre, m) • Describe and calculate the changes in energy involved when a system is changed by work done by forces.

	• Recall and use the equation to calculate the change in gravitational PE when an object is raised above the ground: change in gravitational potential energy (joule, J) = mass (kilogram, kg) × gravitational field strength (newton per kilogram, N/kg) × change in vertical height (metre, m). • Recall and use the equation to calculate the amounts of energy associated with a moving object: kinetic energy (joule, J) = 0.5 × mass (kilogram, kg) × (speed)^2 • Explain, using examples, how in all system changes energy is dissipated so that it is stored in less useful ways. • Explain that mechanical processes become wasteful when they cause a rise in temperature so dissipating energy in heating the surroundings. • Define power as the rate at which energy is transferred and use examples to explain this definition. • Recall and use the equation: power (watt, W) = work done (joule, J) ÷ time taken (second, s) • Recall that one watt is equal to one joule per second, J/s. • Recall and use the equation for efficiency. Magnetism and the motor effect • Recall that unlike magnetic poles attract and like magnetic poles repel • Describe the uses of permanent and temporary magnetic materials including cobalt, steel, iron and nickel • Explain the difference between permanent and induced magnets • Describe the shape and direction of the magnetic field around bar magnets and for a uniform field, and relate the strength of the field to the concentration of lines • Describe the use of plotting compasses to show the shape and direction of the field of a magnet and the Earth's magnetic field • Explain how the behaviour of a magnetic compass is related to evidence that the core of the Earth must be magnetic. • Describe how to show that a current can create a amagnetic effect and relate the shape and direction of the magnetic field around a long straight conductor to the direction of the current • Recall that the strength of the field depends on the size of the current and the distance from the long straight conductor • Explain how inside a solenoid the fields from individual coils add together to form a very strong almost uniform field along the centre of the solenoid, or cancel to give a weaker field outside the solenoid. • **Recall that a current carrying conductor placed near a magnet experiences a force and that an equal and opposite force acts on the magnet** • **Explain that magnetic forces are due to interactions between magnetic fields**

	• **Recall and use Flemming's left hand rule to represent the relative directions of the force, the current and the magnetic field for cases where they are mutually perpendicular** • **Use the equation *F = B x I x l*** Electromagnetic induction • **Recall the factors that affect the size and direction of an induced potential difference and describe how the magnetic field produced opposes the original change** • **Explain how an alternating current in one circuit can induce a current in another circuit in a transformer** • **Recall that a transformer can change the size of an alternating current** • Explain why, in the national grid, electrical energy is transferred at high voltages from power stations, and then transferred at lower voltages in each locality for domestic uses at it improves the efficiency by reducing heat loss in transmission lines • Explain where and why step-up and step-down transformers are used in the transmission of electricity in the national grid • Use the power equation for transformers with 100% efficiency Maths and scientific skills running throughout the science specifications: • Demonstrate an understanding of number, size and scale and the quantitative relationship between units • Calculate with numbers written in standard form • Calculate surface area: volume ratios • Plot, draw and interpret appropriate graphs • Translate information between numerical and graphical forms • Construct and interpret frequency tables and diagrams, bar charts and histograms • Extract and interpret information from graphs, charts and tables • Extract and interpret data from graphs, charts and tables • Ue percentiles and calculate percentage gain and loss of mass • Use orders of magnitude to evaluate the significance of data • Estimate size and scale of atoms and nanoparticles • Use ratios when considering relative sizes and surface area to volume comparisons • Calculate surface areas and volumes of cubes • Make calculations using ratios and proportional reasoning to convert units and to compute rates

	Apparatus and techniques used throughout the topics: ● Use of appropriate apparatus and techniques for the observation and measurement of biological changes and/or processes ● Measurement of rates of reaction by a variety of methods, including production of gas, uptake of water and colour change of indicator ● Application of appropriate sampling techniques to investigate the distribution and abundance of organisms in an ecosystem via direct use in the field ● Use of appropriate apparatus techniques and magnification, including microscopes, to make observations of biological specimens and produce labelled scientific drawings ● Safe use and careful handling of gases, liquids and solids, including careful mixing of reagents under controlled conditions, using appropriate apparatus to explore chemical changes and/ or products ● Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater ● Use of appropriate qualitative reagents and techniques to analyse and identify unknown samples or products including gas tests, flame test, precipitation reactions, and the determination of concentrations of strong acids and strong alkalis ● 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. ● Use of appropriate apparatus to measure and observe the effects of forces including the extension of springs	
Skills	R Develop RESILIENCE	★ Always striving to improve answers by including key vocabulary and backing up thoughts with scientific explanations. ★ Working through challenging situations , reflecting as to why a practical might not produce the expected results and adapting their technique to collect accurate results.
	A Possess AMBITION	★ Seeking to answer scientific questions through analysis of experimental results. ★ Devising models and analogies for tricky and abstract scientific concepts. ★ Write effectively and coherently using Standard English appropriately.

				★ Using assessment to make progress – designated improvement and reflection time (Green for Growth) is built in following class assessments, summative assessments and any other teacher marked work.		
	I Demonstrate INTEGRITY			★ Completing practical work sensibly baring in mind the safety of themselves and others. ★ Taking responsibility for their studies and individual revision ★ Using problem solving skills to work through scientific models.		
	S Embed Self-Discovery			★ Sharing their own ideas of scientific questions during class discussions. ★ Asking scientific questions, carrying out investigations to find out the answers to scientific questions. ★ Students must reflect upon real world advancements and consequences of science such as nanoparticles and polymers and the effects of humans on the ecosystems and food chains and webs.		
	E Display EMPATHY			★ Respecting the laboratory and others during practical experiments by helping to get equipment for others, compare experimental techniques and keeping the laboratory tidy. ★ Showing respect for the class teacher and other students by listening to and contributing to class discussions. ★ Respecting other people's opinions and ideas.		
Curriculum Links	KS3 Links- The plants topic links to work covered in year 8 around ecosystems and plants.	KS3 Links- The animal coordination and control topic links to year 7 body	A level links - A-level chemistry links- AQA 3.2 Inorganic chemistry-3.2 Inorganic	KS4 Links- Paper 2 in Biology, Chemistry and Physics has a cross over with Paper 1 Key concepts in biology, key concepts in		

	Magnetism links to when magnets were first introduced in year 8. A level links - A-level biology links: AQA 3.3 Organisms exchange substances with their environment. A-level chemistry links: AQA 3.3 Organic chemistry and Earth's atmosphere A-level physics links: magnetism	systems and year 8 healthy lifestyle as well as year 9 health. The particle model, forces and matter topic relates to particles and behaviour topics taught in year 7 and 9 as well as the forces topic taught at the beginning of year 7. A level links - A-level chemistry links: AQA 3.3 Organic chemistry unit- alkanes, alkenes, alcohols, carboxylic acids A-level biology links: AQA 3.4	chemistry unit- reactions of ions in aqueous solution	chemistry and key concepts in physics.		

		and 3.5 Energy transfer in and between organisms, relationships between organisms				
Assessment	Per each subject students will experience the following assessments: Curriculum Checkpoint 1 AP1 Assessment Paper	Per each subject students will experience the following assessments: Curriculum Checkpoint 2	Per each subject students will experience the following assessments: AP2 assessment Curriculum Checkpoint 3	Per each subject students will experience the following assessments: AP3 assessment Curriculum Checkpoint 4		
Aspirations & Careers	Separate science students are invited to participate in small group STEM career events including a marine biology school, Dr for the day and a talk about radioactivity from a company within the local sector.					