Alcester Academy Curriculum Planning: Key Stage 4 (Year 11)

Department: Science Year Group: 11						
Term	Topic/Subject	Assessment Objectives and Knowledge acquisition	Skill building *Intent*	Wider reading to include numeracy and SMSC	SEND & PP Identify where access and learning is supported	Final assessment task and title
Autumn	B4 Photosynthesis and respiration (Bioenergetics)	Adaptations of cells and tissues in leaves allow them to photosynthesise efficiently. Stomata are adapted to control the exchange of gases. Cells and tissues in leaves, stems and roots are designed for the maximum exchange of substances in and out of the plant The useful products of photosynthesis are simple carbohydrates, for example glucose ad sucrose. Different environmental factors interact to limit the rate of photosynthesis in different habitats at different times. The environment in which plants are grown can be artificially manipulated. There are two transport	Required practical Investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed Maths skills: Surface area to volume ratio	Recognise and use expressions in decimal form Use ratios, fractions and percentages Use an appropriate number of significant figures Find arithmetic means. Construct and interpret frequency tables and diagrams, bar charts and histograms Understand the terms mean, mode and median Understand and use the symbols: =, <, <<, >>, >, ∝, ~. Solve simple algebraic equations.	Students are ability set Smaller groups for set 4 and 5 Careful seating plans All PP will be offered a revision guide Encourage use of HW club Content differentiation as highlighted between triple, higher and foundation Use of TA support in lessons Bespoke revision support where available	Photosynthesis required practical – results and conclusion End of unit test.

		systems in plants: xylem transports water up the plant and phloem transports substances up and down the plant. Water movement through the plant is affected by different environmental factors. Water loss in plants is a consequence of adaptations for photosynthesis. Different factors affect the rate of diffusion in plant systems. Concentration gradients can affect the rate of photosynthesis. Substances move in and out the leaf during different processes, for example, photosynthesis, respiration and transpiration.		Translate information between graphical and numeric form. Plot two variables from experimental or other data Wider reading around the use of plant based medicine Understand the roles plants play in our lives and how we can maintain and increase them Discuss the impact of deforestation Appreciate the use of chemicals in farming and the short and long term impacts of these	Use of LSU to chase parents evening appointments and follow up	
Autumn	C4 Chemical changes	Understand that metals react with oxygen to produce metal oxides. Explain oxidation and reduction in terms of gain or loss of oxygen. Recall and describe the reactions of certain metals with dilute acids and place them in	Apply knowledge of a range of techniques, instruments, apparatus and materials to select those appropriate to the experiment.	Forming chemical equations reinforcement. Issues of safety with use of chemicals	Issues of safety with use of chemicals Reactivity of metals linked to their use and extraction – conserving resources for future generations	End of topic test Making copper sulphate 6 mark question Making salts worksheet.

		order of reactivity. Explain that the reactivity of a metal relates to its ability to form a positive ion. Deduce an order of reactivity bases on results. **Higher only:** Explain oxidation and reduction in terms of electron transfer. Write ionic equations for displacement reactions. Identify which species are being oxidised and reduced. To know that acid and alkali yields salt and water. To be able to name the salt produced based upon the acid and the alkali used. To know that acid and carbonate yields salt and water and carbon dioxide. Use the formulae and common ions to deduce formulae of salts. To explain how soluble salts can be formed from acid and metals, metal oxides and hydroxides **Required practical:** To make an sample of a soluble salt from an insoluble oxide or carbonate.	Correctly manipulate apparatus to carry out an experiment affectively. Safe use of equipment.	Reactivity of metals linked to their use and extraction – conserving resources for future generations Forming chemical equations reinforcement. Constructing a method for the practical. Issues of safety with use of chemicals Reactivity of metals linked to their use and extraction – conserving resources for future generations Make order of magnitude calculations.		

		To understand what the pH scale shows and how such values can be measured in a laboratory. To understand that acids produce H^+ ions and that alkalis produce OH^- ions in solution. **Higher only:** Be able to explain why acids are considered to be strong or weak. Explain the difference between dilute and weak acids, and weak and strong acids. Explain pH value in terms of the concentration of hydrogen ions in solution and know what as the pH value decreases by 1, the hydrogen ion concentration increases by a factor of 10. Know that for a molten ionic substance, the metal is produced at the negative anode and that the non-metal is produced at the positive cathode. State when it is appropriate to use electrolysis as a method for metal extraction. Know that lots of energy is required in electrolysis.	se a variety of models to solve problems, make predictions and develop scientific explanations of familiar and unfamiliar facts.	Practical method write up. Balancing equations.		

		For the separation of aluminium oxide, state why mixture with cryolite is necessary. Explain why the anode muse be continually replaced. Students should be able to predict the products of the electrolysis of aqueous solutions containing a single ionic compound. **Required practical:** investigate what happens when aqueous solutions are electrolysed using inert electrodes. **Higher only:** to be able to represent oxidation and reduction reacts at the cathode and anode as half equations.				
Autumn	B2 Human Organisation	Understand what cells, tissues, organs and organ systems are. Describe the structure and function of the digestive system. Explain what enzymes are and how they work using the "lock and key" model. Relate the factors temperature and pH to their rate of action. To recall the sites of lipase, amylase and protease production and state their functions.	Be able to convert between units. Build up an appreciation of size and scale. Mathematics improvement through enzyme rate calculations. Use appropriate apparatus to measure values. Plan	Interpret graphs of breathing, HR etc Wider reading around transplants Calculations. Discussions around the use of transplanted organs Links to health and responsibility to maintain		End of topic test. practical on enzyme activity write up sheet.

		To state the products of the breakdown of carbohydrates, lipids and proteins and recognise simple equations to represent these changes. Explain what bile does and how it achieves its function. **Required practical:** To carry out food tests for starch, reducing sugars, lipids and proteins. **Required practical:** To carry out an investigation into the effect that pH has on amylase's ability to break down starch State and describe differences between the three type of blood vessels. Describe how to structure of these vessels relates to their function. Be able to name the different parts of the heart and explain what is meant by the double-circulatory system. Explain how the heart beat is controlled. State the three components of the blood and describe the function of each.	experiments to make observations and test hypotheses. Evaluate methods and suggest possible improvements and further investigations. Present observation using appropriate methods. Safely use a microscope to observe blood cells. Evaluate different methods of treatment bearing in mind the risks associated with each. Translate disease information between different forms to identify a correlation between two variables.	our own health eg diet, smoking Appreciating risk factors for illnesses. To appreciate some of the choices in life that can lead to negative health conditions. Constructing a method for the practical activity. . Promoting construction of evaluate method Interpret data on histograms, bar charts, frequency tables and scatter diagrams to study incidences of diseases. Understanding the principles of sampling as applied to scientific data.		

		Describe what causes coronary heart disease and evaluate the advantages and disadvantages of treating this by either use of drugs, mechanical devices or transplant. Be able to describe the differences between health and disease and the interactions between certain types of disease To outline some of the factors that may increase the risk of one developing non-communicable diseases. Describe the negative impacts that non-communicable diseases have at an individual, national and global level. To describe cancer as uncontrolled cell division. To explain the difference between malignant and benign tumours and explain how they can spread to form secondary tumours. To outline some of the risk factors for cancer.	Interpret data about risk factors			
Autumn	P5 Forces	To understand what a scalar and vector quantity is, with examples. To describe what a force is and give examples of contact and non-contact forces.	Be able to recall and apply the equation for weight.	Apply the formula for weight with given variables. Conversion of units.		Required practical acceleration

		Be able to describe the interaction between pairs of objects which produce a force on each other. Be able to describe what weight is and how the force of gravity changes around the Earth. Be able to calculate the weight of an object from its mass and gravitational field strength. Know that weight is measured using a calibrated spring-balance. Understand what resultant force is and be able to calculate the resultant force of two forces acting in a straight line. (HT) Be able to describe examples of forces acting on an isolated object or system. (HT) Be able to use free body diagrams to describe qualitatively examples where several forces lead to resultant force on an object, including balanced forces. To understand what work done is. Recall and apply the equation for calculating work done using force and distance moved. Be able to describe the energy transfer when work is done. Be able to convert between newton-metres and joules.	Be able to recognise and use the symbol of proportionality. Be able to recall and apply the equation for work done. Be able to safely demonstrate Hooke's law though practical. Be able to recall and apply the equation for force on a spring. Be able to apply the equation for elastic potential energy. Using appropriate equipment to make and record a range of measurements and observations accurately in order to investigate the relationship between force and extension of a spring. Use results to produce a graph. ***Be able to recall and apply the equation***	Apply the formula for work done with given variables. Rearrange equations. Apply the formula for force on a spring with given variables. Apply the formula for elastic potential energy with given variables. ***Apply the equation for moments of a force.*** ***Apply the equation for calculating pressure at the surface of a fluid.*** ***Apply the equation for calculating pressure in a column of liquid.*** Change the subject of an equation. Substitute numerical values into algebraic equations using appropriate units. Use ratios and proportional reasoning to convert units and compute rates.		6 mark question -Stopping distance

		Be able to give examples of the forces involved in stretching, bending or compressing objects. Be able to explain why to change the shape of a stationary object more than one force has to be applied. Be able to describe the difference between elastic deformation and inelastic deformation caused by stretching forces. Know that the extension of an elastic object, such as a spring, is directly proportional to the force applied, provided the limit of proportionality is not exceeded (Hooke's law). Be able to calculate force on a spring using it's spring constant and extension. Describe the difference between a linear and non-linear relationship between force and extension. Be able to calculate a spring constant in linear cases. Be able to interpret data from an investigation between force and extension. Calculate work done in stretching a spring using the equation given for elastic potential energy.	***for moment of a force.*** ***Be able to recall and apply the equation for calculating pressure at the surface of a fluid.*** ***(HT) Be able to apply the equation for calculating pressure in a column of liquid.***	Apply the equation for calculating speed. Measure speed and distance Draw graphs of distance / time Apply the equation for calculating acceleration Draw graphs of velocity and time Find the gradient of a graph Apply the equation to calculate resultant forces Engineers analyse forces when designing many machines and instruments we use every day, from road bridges, fairground rides and cars. Recent developments using analysis of forces include artificial limbs to make movement possible for disabled people. Understand how terminal velocity relates to parachutes.		

		Conduct a required practical to investigate the relationship between force and extension of a spring. ***Describe the turning effect of a force about a pivot.*** ***Explain and use the principle of moments.*** ***Calculate the size of moments.*** ***Be able to explain how levers and gears transmit the rotational effects of forces.*** ***Understand a fluid is a liquid or gas.*** ***Describe the pressure in fluids and calculate the pressure at the surface of a fluid.*** ***(HT) Be able to calculate the pressure due to a column of liquid and the differences in pressure at different depths in a liquid.*** ***(HT) Be able to describe the factors which influence floating and sinking.*** ***Be able to describe a simple model of the earth's atmosphere and of atmospheric pressure.*** ***Explain why atmospheric pressure varies with height above a surface.*** To be able to express a displacement in terms of magnitude and direction.	Recall and apply the equation for calculating speed. Using appropriate equipment to measure distance and time accurately. Draw graphs of distance and time to calculate speed. Recall and apply the equation for calculating acceleration. Draw graphs of velocity and time to calculate acceleration. ***Calculate displacement of an object by calculating the area under a velocity-time graph***			

		Recall that speed is a scalar quantity and typical values of speed for a person walking, running, cycling and speed for different types of transportation. Recall speed of sound is 330m/s. Be able to measure distance and time to calculate speed of objects and use the distance = speed x time equation, Recall that velocity is a vector quantity. (HT) Explain qualitatively, with examples, that motion in a circle involves constant speed but changing velocity. Be able to draw distance-time graphs from measurements and extract and interpret lines and slopes. Be able to determine speed from the gradient of a distance-time graph. (HT) Be able to calculate the speed of an accelerating object at a particular time by drawing a tangent and measuring the gradient of the distance-time graph. Be able to calculate acceleration using the equation acceleration = change in velocity/ time taken.	***Investigate the effect of air resistance on a falling object.*** Be able to recognise the symbol for proportionality Recall and apply the equation to calculate resultant force Recognise and use the symbol for approximate value Use appropriate equipment to make and record measurements to investigate the effect of force on acceleration			

		Be able to calculate the acceleration of an object from the gradient of a velocity-time graph. Be able to apply the equation to calculate uniform acceleration. Know that an object falling freely under gravity has an acceleration of about 9.8m/s^2 Understand that eventually an object falling through a fluid will move at its terminal velocity. ***Be able to draw and interpret velocity-time graphs for objects that reach terminal velocity, and. Be able to interpret the changing motion in terms of forces acting.*** To understand and apply Newton's First Law regarding resultant forces and motion of objects. (HT) To know what inertia is. To understand Newton's second Law of motion regarding the acceleration of an object. Be able to recognise and use the symbol for proportionality Be able to recall and apply the equation: resultant force = mass x acceleration. (HT) be able to explain that initial mass is a measure of how				

		difficult it is the change velocity of an abject and is defined as a ratio of force over acceleration. Be able to estimate speed, accelerations and forces and recognise the symbol for approximate value/answer To be able to carry out the required practical to 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. Be able to describe and apply Newton's Third Law when objects interact they exert equal and opposite forces on each other. To know what the stopping distance of a vehicle is. ***Be able to estimate how the distance for a vehicle making an emergency stop varies over a range of speeds.*** ***Be able to interpret graphs relating to stopping distances.*** Know that reaction times vary between people and can be affected by tiredness, drugs, alcohol and distractions. Be able to explain how to measure human reaction times				

		Be able to interpret and evaluate measurements to measure reaction times. Be able to evaluate the effect of various factors on thinking distance from given data.				
Spring	C6 Rates of reaction	Be able to find the rate of a chemical reaction by measuring the quantity of reactant or product used in g/s or cm^3/s. (HT) use quantity of reactants in moles and rate of reaction in mol/s. Be able to draw and interpret graphs showing the quantity of product formed or reactant used up against time. Draw tangents to the curves of reaction rate graphs and use the slope of the tangent to measure the rate of reaction. (HT) calculate the gradient of a tangent to the curve on a reaction rate graph. Understand the factors which affect the rate of chemical reactions as concentrations of reactants, pressure, surface area, temperature and catalysts. Conduct a required practical to investigate how changes in concentration affect rates of reaction.	Safely using specified equipment and conduct practicals to measure the rate of reactions. Take accurate measurements of changes in mass or gas volume. Calculate rates of reaction from experimental data. Draw graphs from experimental data, determining slope and intersect. Conduct a practical to investigate how changes in concentration affect reaction rate. Develop a hypothesis.	Using ratios, fractions and percentages. Measuring Conversion of units. Drawing and interpreting graphs. (HT) calculating gradient of a tangent. Calculate means. Safely working with others. Understanding that in industry chemists and chemical engineers determine the effect of different variables on reaction rates to maximise the yield of product in an energy and time efficient way.		Graph question on rates of reaction Concentration 6 marker – method for practical

		Be able to explain how collision theory affects rates of reactions. Make predictions and explain the effects of changing conditions of reactions including changing the surface area to volume ratio. Be able to explain how catalysts affect the rate of reactions and explain catalytic action in terms of activation energy. Be able to identify and explain the reaction profile for a catalysed reaction. Be able to describe what a reversible reaction is. Understand energy changes in reversible reactions in terms of exothermic one direction, endothermic the opposite direction. Understand when equilibrium in a reversible reaction is reached. (HT) Be able to predict the effects of changing conditions on a system at equilibrium, applying Le Chatelier's Principle. (HT) Be able to interpret data to predict the effect of a change in concentration of a reactant or product, the change in temperature of a system and the change in pressure of a	Conduct a practical to investigate catalytic effects on reactions.			

		system on given reactions at equilibrium.				
Spring	P7 Electromagnetism	Explain what is meant by the poles of a magnet. Plot the magnetic field around a bar magnet. Describe magnetic materials and induced magnetism. Describe the Earth's magnetic field. Describe the magnetic effect of a current. Draw the magnetic field around a conducting wire and a solenoid. Describe the force on a wire in a magnetic field. Explain the meaning of magnetic flux density, B. Calculate the force on a current-carrying conductor in a magnetic field. List equipment that uses motors. Describe how motors work. Describe how to change the speed and direction of rotation of a motor. Explore how electricity and magnetism are connected. Describe simple uses of electromagnets.	Students should be able to apply this equation which is given on the Physics equation sheet. force = magnetic -ux density × current × length Safe use of electricity.			Plotting a magnetic field practical Triple – how does a loud speaker work End of unit test

		Change the subject of an equation. **Fleming's left-hand rule (HT only)** **Electric motors (HT only)** **Loudspeakers (physics only) (HT only)** **Induced potential, transformers and the National Grid (physics only) (HT only)** an electrical conductor moves relative to a magnetic field or if there is a change in the magnetic field around a conductor, a potential difference is induced across the ends of the conductor. If the conductor is part of a complete circuit, a current is induced in the conductor. This is called the generator effect. **Uses of the generator effect (HT only)** **Microphones (HT only)** Microphones use the generator effect to convert the pressure variations in sound waves into variations in current in electrical circuits.				

		Students should be able to explain how a moving-coil microphone works. **Transformers (HT only)** A basic transformer consists of a primary coil and a secondary coil wound on an iron core. explain how the effect of an alternating current in one coil in inducing a current in another is used in transformers •• explain how the ratio of the potential differences across the two coils depends on the ratio of the number of turns on each •• calculate the current drawn from the input supply to provide a particular power output MS 3b, c Students should be able to apply this equation which is given on the Physics equation sheet. •• apply the equation linking the pds and number of turns in the two coils of a transformer to the currents and the power transfer				

		involved, and relate these to the advantages of power transmission at high potential differences				
Spring	C10 using Resources	Give examples of natural products replaced by synthetics. Give examples of products replaced by agricultural products. Distinguish between finite and renewable resources. Distinguish between potable water and pure water. Describe the differences in treatment of groundwater and salty water. Give reasons for the steps used to produce potable water. Describe how safety is managed, apparatus is used and accurate measurements are made. Recognise when sampling techniques need to be used and made representative. Explain how waste water is treated. Describe how sewage is treated.	Evaluate methods and suggest possible improvements and further investigations. Evaluate ways of reducing the use of limited resources. To represent information from pie charts numerically. To represent information from graphs numerically. To represent information from numerical form graphically.	Use ratios, fractions and percentages; Make order of magnitude calculations; Translate information between graphical and numeric form. Recognise and use expressions in decimal form; Use ratios, fractions and percentages; Make estimates of the results of simple calculations; Use an appropriate number of significant figures; Translate information between graphical and numerical forms. Use ratios, fractions and percentages Recognise and use expressions in standard form. Metal recycling as an environmental and economic issue. Impact of humans on the environment.		Required practical waste water sheet Comparison of glass and water milk bottles Advantages and disadvantages of recycling End of unit test

		Compare the ease of treating waste, ground and salt water. Describe the process of phytomining. Describe the process of bioleaching. Evaluate alternative biological methods of metal extraction. Describe the components of a Life Cycle Assessment (LCA). Interpret LCAs of materials or products from information. Carry out a simple comparative LCA for shopping bags. Describe ways of recycling and reusing materials. Explain why recycling, reusing and reducing are needed.		Recycling as an environmental and economic issue. Use of life cycle assessments in industry. Discussion of lack of potable water around the world. Human impact on the marine environment – over fishing and plastic pollution.		
Spring	*P8 Space – triple award students only*	Describe the orbits of planets and moons in the Solar System. Distinguish between planets, dwarf planets and moons. Compare the orbital motion of moons, artificial satellites and planets in the Solar System. Describe what keeps bodies in orbit around planets and stars.	Understand the scale of objects in the Universe.	Use standard form space probes – links to engineering and technology history of lunar exploration – links to aerospace engineering Lenses in telescopes – optometry		Life cycle of a star End of unit test

		Explain how for circular orbits, an object can have a changing velocity but unchanged speed. Explain why bodies must move at a particular speed to stay in orbit at a particular distance. Describe how the Sun and other stars formed. Describe the nuclear fusion reactions in the Sun. Describe the main sequence stage of a star's life cycle. Identify the forces that are in equilibrium in a stable star. Describe the life cycles of a star like the Sun and a massive star. Understand how new elements are produced by nuclear fusion inside a star. Recognise that the heavier elements are made in a supernova. Describe red-shift. Describe evidence for the expanding Universe. Understand that gravity provides the force that keeps planets and satellites in orbits. Understand that gravity is necessary at the start of a star's				

		life cycle and to maintain equilibrium in a stable star. Describe how the weight of an object depends on the gravitational field strength. Recognise that that there is still much about the universe that is not understood, for example dark mass and dark energy. .				
Spring	C8 chemical analysis	Describe, explain and exemplify processes of separation. Suggest separation and purification techniques for mixtures. Distinguish pure and impure substances using melting point and boiling point data. Identify formulations given appropriate information. Explain the particular purpose of each chemical in a mixture. Explain how quantities are carefully measured for formulation. Explain how to set up paper chromatography. Distinguish pure from impure substances. Interpret chromatograms and determine R_f values. chromatography apparatus and how accurate	● Recall the tests for four common gases. ● Identify the four common gases using these tests. ● Explain why limewater can be used for testing CO_2. ● Measure distances on chromatograms. ● Calculate R_f values. Record R_f values to an appropriate number of significant figures. ***Triple only- Identification of ions by chemical and spectroscopic means (chemistry only) Flame tests An***	Make estimates of the results of simple calculations. Use ratios, fractions and percentages. Recognise and use expressions in decimal form.		Required practical chromatography Method for the different tests – triple only End of unit test

		measurements are achieved. Make and record measurements used in paper chromatography. Calculate R_f values Recall the tests for four common gases. Identify the four common gases using these tests. Explain why limewater can be used for testing CO_2. Measure distances on chromatograms. Calculate R_f values. Record R_f values to an appropriate number of significant figures. ***Triple only- Identification of ions by chemical and spectroscopic means (chemistry only) Flame test, Metal hydroxides, Carbonates, Halides, Sulfates. Instrumental methods Flame emission spectroscopy***	***opportunity to investigate flame colours. An opportunity to make precipitates of metal hydroxides. Required practical 7: use of chemical tests to identify the ions in unknown single ionic compounds covering the ions from sections Flame tests to Sulfates. An opportunity to observe flame spectra using a hand-held spectroscope.***			