The Science KS4 Curriculum at TAL

Phase 2 Overview

In Year 10 our students follow the OCR Gateway specification. Students either follow the combined science pathway to achieve 2 GCSE grades or the separate science pathway to attain GCSE's in Biology, Chemistry and Physics. All of the combined content is found within the three separate GCSEs, but these also include additional statements. By the end of year 10 students will have revisited, consolidated and deepened many of the golden threads, the fundamentals, addressed during their five-year journey. Within biology, students will have moved from cells and organ systems to organisms as a whole, and how organisms interact with one another and the ecosystem. In chemistry, the formulae and equations previously encountered will be used to describe reactions and to predict trends on the periodic table based on experimental observations. In physics, the contact forces explored in year 9 will now be expanded to look at non-contact force, last addressed in year 7. Within all topics the mathematical skills of students will continue to develop to enable them to articulate conclusions and support with mathematical evidence. Practical skills will have continued to develop, and students should now be able to select appropriate equipment for an experiment and state how to ensure their results are valid. By the end of year 11 students will have tied together the learning throughout their five-year learning journey within the final units called 'Global Challenges'. Within these final units for biology, chemistry and physics students will learn of the biggest challenges facing the human race: within biology the spread and treatment of disease and its impact on food security; within chemistry our use of finite resources, how they can be preserved and how their use damages the environment and within physics the energy crisis and how we can reduce our use of fossil fuels while maintaining our current energy dependent lifestyles. Students will now be able to apply their scientific literacy and numeracy skills to select appropriate equipment and plan a method to collect valid data, be able to process, analyse and evaluate complex data.

Unit	Knowledge	(Disciplinary Knowledge)	Maths	Rationale: *why this, why here, why now?*	Academy Key Drivers: *Empower, Literacy, Diversity, PD, Voice*, Careers
C3 Chemical Reactions	Introducing Chemical Reactions • Use chemical symbols to write the formula of elements and compounds and construct balanced symbol, **half-equations and ionic equations.** • Use the formula of common ions to deduce the formula of a compound • Describe the physical states of products and reactants using state symbols. • **Recall and use the definition of the Avogadro constant and of the mole** • **Explain the link between mass and number of moles** • Recall and use the law of conservation of mass and explain any changes of mass in terms of chemical reactions and the particle model • **Deduce the stoichiometry of an equation, explain the effect of limiting reactants, and calculate masses of reactants and products using a balanced symbol equation.** Testing for gases Golden thread - particles Energetics • Use enthalpy data, along with reaction profiles, to distinguish between endothermic and exothermic reactions. • Draw and label a reaction profile for an exothermic and an endothermic reaction • Explain the need for activation energy. • **Calculate energy changes in a chemical reaction by considering bond making and bond breaking energies.** Measuring the temperature change in reactions. Golden thread - energy Types of chemical reaction • Explain reduction and oxidation in terms of oxygen and **electrons**. **Use this to explore the concept of oxidising and reducing agents.** • The reaction of acids is explored using word and balanced symbol equations when reacting with: o Alkalis/bases (neutralisation) o Carbonates o Metals • Acidity will be explored in the context of: o Techniques and apparatus used to measure pH o Describe titration technique o **Dilute and concentrated acids** o **Strong and weak acids** o **Concentration of H^+ ions at each pH (each pH is a factor of 10)** Production of pure dry sample of salt.	Recall of content Using models to explain scientific ideas Data analysis Recall of content Presenting and collecting data, plan for variables, drawing conclusions, discussing limitations, analysing patterns, evaluating risks, justifying opinions, evaluating methods Application of the terms: accuracy, validity, reproducible, repeatable and precision. Drawing and interpreting graphs Using models to explain scientific ideas Data analysis	Arithmetic computation and ratio when balancing equations. **Calculations with numbers written in standard form when using the Avogadro constant** Provide answers to an appropriate number of significant figures. Convert units where appropriate **particularly from mass to moles** Arithmetic computation and ratio when determining empirical formulae and balancing equations. **Calculations with numbers written in standard form when using the Avogadro constant.** Provide answers to an appropriate number of significant figures. Convert units where appropriate **particularly from mass to moles.** Standard form conversion Interpret charts and graphs when dealing with reaction profiles. Arithmetic computation when calculating energy changes. Arithmetic computation, ratio, percentage and multistep calculations throughout quantitative chemistry. Unit conversion (cm^3 to dm^3) Arithmetic computation and ratio when determining empirical formulae and balancing equations.	Chemical reactions build on knowledge explored in Phase 1 in terms of the use of symbols to represent chemicals and compounds. Students will now be expected to construct the formula for the compounds, which builds on the knowledge developed in Element, Compounds and Mixtures in terms of creating ionic and covalent compounds and molecules. Mathematical skill required for the higher tier sections, particularly the use of standard form when using the Avogadro constant can now be introduced as students will have practiced using this in Maths lessons in Y9. Science teachers can therefore build on the mathematical skills that have already been developed in a scientific context. Chemical reactions build on knowledge explored in year 7 and 8 in terms of the use of symbols to represent chemicals and compounds. Students will now be expected to construct the formula for the compounds, which builds on the knowledge developed in Elements. Compounds and Mixtures in terms of creating ionic and covalent compounds and molecules. Knowledge of endothermic and exothermic reactions first explored in year 8 in the context of photosynthesis and respiration can now be extended and deepened, with a sharper focus on mathematical analysis. Neutralisation first encountered in year 7 is now explored to a greater depth through the use of word, symbol and ionic half equations to cement understanding of what occurs during chemical reactions. In year 10 this unit is sequenced to follow Particles and Element, compounds and mixtures as the content of both units will now be revisited and explored in the context of reactions and separation of impure substances using electrolysis. Mathematical skill required for the higher tier sections, particularly the use of standard form when using the Avogadro constant can now be introduced as students will have practiced using this in Maths lessons in Y9. Science teachers can therefore build on the mathematical skills that have already been developed in a scientific context.	Oxidation Carbonate Reduction Neutralisation	PD – acidity – affecting wildlife. Careers – water analyst, environmental scientist, wildlife surveys, chemical engineer, electroplating. CC – acidity of rivers/streams and lakes and the effect on the wildlife CC – use of explosives for demolition purposes (releasing high amounts of enthalpy) CC- calculations of enthalpy change help scientists identify the best food and fuel to use Careers – water analyst, environmental scientist, wildlife surveys, chemical engineer, electroplating. CC – production of Aluminium using electrolysis, electroplating of objects such as jewellery, production of oxygen for use on spacecraft and nuclear submarines. Production of hydrogen as an alternative fuel source PD – Nicholson & Carlisle in 1800 discovered how electrolysis works and decomposed water into hydrogen and oxygen

	Golden thread - particles Electrolysis • Describe, in relation to all ions present, the products formed at the anode and cathode if the electrolyte is: o A molten ionic compound o An aqueous ionic compound • Describe electrolysis when using inert and non-inert electrodes. **Electrolysis of sodium chlorides solution.** Electrolysis of copper sulfate solution Golden thread - particles					
P3 Electricity and magnetism	Static and Charge • Describe that charge is a property of all matter and how charged objects interact. • Explain the production of static electricity on insulators in terms of electron transfer when surfaces rub. • Describe current as the rate of flow of charge, and that current is the same at all points in a single closed loop. • Use: $charge = current \times time$ Golden thread – particles and energy Simple Circuits • Describe the difference between series and parallel circuits in terms of structure, current, energy and potential difference. o $Energy = charge \times p.d.$ o $Energy = power \times time$ • Represent d.c. circuits with conventions of positive and negative terminals, and the symbols to represent common circuit elements. • Use Ohm's law to describe how resistance changes in fixed resistors, lengths of wire, filament lamps and diodes. o $p.d. = current \times resistance$ • Use circuit design to explore potential uses of LDRs and NTC thermistors • Qualitative explanation only of the addition of resistors into a series and parallel. • Explain the design and use of circuits • Calculate power of devices using current and p.d. • Explain how power transfer is related to potential difference, current and energy changes. o $power = p.d. \times current$ $power = current^2 \times resistance$ Investigate resistance Golden thread – energy, forces and particles Magnets and magnetic fields • Describe the attraction and repulsion of magnets (to include drawing field lines in both cases)	Recall of content Presenting and collecting data, plan for variables, drawing conclusions, discussing limitations, analysing patterns, evaluating risks, justifying opinions, evaluating methods Application of the terms: accuracy, validity, reproducible, repeatable and precision. Drawing and interpreting graphs Using models to explain scientific ideas Data analysis	Significant figures and substituting into equations Expressions in decimal form, and give values to an appropriate number of significant figures when changing the subject of equations and substituting into charge = current x time Expressions in decimal form and give values to an appropriate number of significant figures when changing the subject of equations and substituting into numerous equations. Use 2D diagrams to represent 3D magnetic fields. Use ratios to describe changes in number of turns on a solenoid. Ratios, fractions and percentages Expressions in decimal form and give values to an appropriate number of significant figures when changing the subject of equations and substituting into force equation. Use graphs to explore whether circuit elements are linear or non-linear. Use graphs and relate the curves produced to function and properties of the circuit element.	Electricity builds on knowledge first explored in year 8. Students will build on knowledge about series and parallel circuits which have been explored in terms of behaviour of current and p.d. Static and charge provides an opportunity to recap the structure of atom and formation of ions previously covered in Matter, Particles and Elements, compounds and mixtures. This will enable students to understand that static charges rely on the formation of ions on the surface of insulating materials. The depth of understanding of current first encountered in year 8 will be deepened with a shaper mathematical focus in applying equations. Simple Circuits provides an opportunity to revisit content from year 8 in terms of standard representation of circuit elements, and the structure of series and parallel circuits. Knowledge is extended through the introduction of new circuit elements such as LDRs, NTC thermistors and diodes. These circuit elements relationships will be explored experimentally and mathematically, before students are asked to exploit their properties in circuit design. Throughout the sub-unit mathematical skills are honed to support exploration of circuit elements and circuit design. Opportunities are presented to revisit previous mathematical skills such as calculating means, plotting scatter graphs and describing the trends in graphs. Magnetism and magnetic fields build on knowledge first gained in year 7. Pupils have already investigated the attraction and repulsion of magnets and will now use magnetic field line diagrams to enable a complete explanation. New learning will explore, magnetic fields around conducting wires, and how this process can be utilised in making a motor rotate. Some students will go on to mathematically explore the size and direction of the force on a conducting wire in a magnetic field.	**Charge** **Power** **Resistance** **Current** **Potential difference**	**Careers -** Electrician Spraying cars – painting and the use of static Engineering **PD -** Greek ideas of Amber and static electricity Flour explosions and saw dust factories due to static Sharing ideas – peer review Faraday society Christmas tree lights and string lights outdoor on parallel circuits. Luigi Galvani's experiments in 1791 with frog legs. **PD -** Earth's magnetic field alternating Using the Earth's magnetic field to data objects Metal detectors – big finds of ancient coins.

	• Describe the difference between permanent and induced magnets. • Explain how dipping compasses provide evidence that the core of Earth must be magnetic. • Describe how you can show that a current can create a magnetic field, and the direction of the magnetic field around a conducting wire. • Explain how solenoid arrangements can enhance the magnetic effect. • **Describe how a permanent magnet and conducting wire apply a force on one another.** • **Show how Fleming's left-hand rule can be used.** • **Apply the equation:** $$\boldsymbol{Force = magnetic\ flux \times length \times current}$$ • **Explain how the force exerted on a conductor can cause rotation in a motor.** Investigation of the magnetic field around a current-carrying wire using plotting compasses Investigation of the factors that can affect the magnetic affect e.g. number of turns, current, length. Golden thread - forces					
B3 Organism Level Systems	<u>Coordination and Control – Endocrine System</u> • Describe the role of hormones, including where they are produced and how they are transported to include: o Role of hormones in human reproduction (how hormones of the menstrual system interact) o Role of thyroxine o Role of adrenaline o Treatment of infertility • Include the principles of negative feedback • Describe methods of hormonal and non-hormonal contraception. • Explain the importance of maintaining a constant internal environment in response to internal and external change • Explain how insulin controls blood sugar levels in the body • Explain how plant hormones are important in control of plant growth and development. • Describe how humans use plant hormones to control plant growth (gibberellins and ethene). • Describe the function of the skin in the control of body temperature • Explain the response of the body to different temperature and osmotic challenges Golden thread – cells and interdependence	Recall of content Drawing and interpreting graphs Using models to explain scientific ideas Data analysis	Extract and interpret data from charts, tables and graphs e.g. relating to reaction time.	**Coordination and Control – Endocrine System. Students have explored the menstrual cycle in Year 7 topic 6. Within this topic students explore how hormones are involved in controlling body reactions and how these are used for fertility and contraception.** **Knowledge of plant structure from phase 1 is built upon with regards to plant hormones and how they control plant growth.**	Endocrine Hormone Secrete Target organ Gland	***PD*** *– The use of hormones in IVF. What are the implications of multiple births and older parents? Fertility* ***PD*** *– If type 2 diabetes is caused by lifestyle is it fair that the NHS has to pay for the care if the patient continues to make poor lifestyle choices?* ***PD*** *– Consent is as important as contraception when making the decision to have sex.* ***PD*** *– Factors that affect reaction time e.g. drink driving.* *– religion and contraception.* **Careers** – Nursing and Gynaecology/Fertility Doctor. Phlebotomist. Careers as a Staff Nurse in diabetes & endocrinology, plus a Consultant in diabetes & endocrinology are reviewed. ***PD*** *– Use of case studies for brain injury when mapping the brain – ethics involved.* **CC** – Hogben pregnancy test in frogs (*Xenopus laevis*)
C4 Predicting and identifying Chemical Reactions	<u>Predicting chemical reactions</u> • Recall and explain the simple properties of groups 0, 1 and 7. • Predict possible reactions and probable reactivity of elements based on their position in the periodic table and electron arrangement.	Recall of content Presenting and collecting data, plan for variables, drawing conclusions, discussing limitations,	Describing trends and patterns in tables (including negative values). Interpreting graphs and predicting trends.	Chemical Reactions and Products builds on knowledge gained in year 7 and 8 about groups and periods of the periodic table, as well as the reactivity of elements in terms of bonding which was explored in Elements, Compounds and Mixtures. Students will now investigate the periodic table further to identify trends and patterns	Halogen Alkali metal Inert	**PD – Hindenburg disaster, mustard gases/chlorine gas in world war.** **CC – Use of argon in welding / lightbulbs to produce a non-reactive atmosphere, lack of flammability.**

	• Deduce an order of reactivity of metals based on experimental results and tendency to form a positive ion. Displacement reactions of halogens with halides Demonstration of group 1 metal reactions with water Reactions of metals with dilute HCl to determine reactivity Displacement reaction involving metals and metal salts Golden thread – particles and energy	analysing patterns, evaluating risks, justifying opinions, evaluating methods Application of the terms: accuracy, validity, reproducible, repeatable and precision. Drawing and interpreting graphs Using models to explain scientific ideas Data analysis	Arithmetic computation and ratio when determining empirical formulae and balancing equations.	which exist and use the trends to predict properties of named elements.		Use of metal ions in fireworks. Use of the halogens in real life applications – iodine in medicine, chlorine in water treatment. Careers –Material scientist, Fire retardant engineer, Welding engineer.
P4 Waves and Radioactivity	<u>Wave behaviour</u> • Define and label key features of transverse and longitudinal waves and terms to describe their motion (amplitude, wavelength, frequency and period) • Describe differences between transverse and longitudinal waves. • Apply: $wave\ velocity = frequency \times wavelength$ • Describe how ripples on water surfaces are used to model transverse waves, and how the speed can be measured. • Describe how speed of sound waves can be measured in air. • Describe evidence that shows that for transverse and longitudinal waves the wave travels, but the matter does not. Investigate of reflection, refraction and wave speed Golden thread - energy <u>The electromagnetic spectrum</u> • Recall that electromagnetic waves are transverse and are transmitted through space at the same velocity. • Describe the main groupings of the electromagnetic spectrum and the associated trend in frequency, energy and wavelength. • Give examples of practical uses of waves on the electromagnetic spectrum, and which waves can be dangerous to the human body. • Recall that our eyes can only detect a limited range. • **Recall that radio waves can be produced or detected by oscillations in electrical circuits.** • **Recall that different substances may absorb, transmit, refract or reflect EM waves that vary with wavelength, and how some effects link to wave velocity.** Golden thread – particles and energy <u>Radioactivity</u> • Recall that isotopes are atoms of the same element and use standard notation to identify differences.	Recall of content Presenting and collecting data, plan for variables, drawing conclusions, discussing limitations, analysing patterns, evaluating risks, justifying opinions, evaluating methods Application of the terms: accuracy, validity, reproducible, repeatable and precision. Drawing and interpreting graphs Using models to explain scientific ideas Data analysis	Expressions in decimal form and give values to an appropriate number of significant figures when changing the subject of equations and substituting into wave velocity equation. Use 2D models to represent 3D EM Spectrum waves. Use angular measures in degree. Recognise and use expressions in standard form, use fractions and substitute numerical values when balancing equations. Use fractions, ratios and percentages to calculate changes relating to half-life. Translate between numerical and graphical data and plot two variables to produce and interpret half-life graphs.	Waves and radiation build on knowledge first encountered in year 7 and 8. Students will also require an understanding of the different states of matter developed in Matter and Particles. Students will require this base knowledge in order to understand how a change in the matter encountered by a wave will determine how the wave's behaviour will change. *Students will explore how we rely on all parts of the EM Spectrum, and how our increase in understanding has allowed for development of technology to treat illnesses.* When students start the final part of the topic, Radioactivity, students will draw on prior knowledge from Particles where students encountered isotopes and atomic structure. This will be broadened to look at how some isotopes can be radioactive, and how their structure changes when they undergo different types of radioactive decay. The mathematical skills of students will continue to develop, specifically solving algebraic equations and substituting values into equations, plotting and extracting information from graphs, particularly in relation to determination of half-life or **net decline.**	Transverse Longitudinal Peak Trough Crest Amplitude Frequency Refraction Electromagnetic	**Careers -** Physics modelling engineer (waves) Radiographer and Medical Physicist. Midwife or physio administering ultrasound. Scientists modelling Tsunami waves Doctor using endoscope Water treatment. UV light kills bacteria in water without the use of chemicals Forensic scientist Nuclear Physics Polymerisation navigators and use of wave diffraction to identify islands Optometrist Nuclear power plant Police/army - thermal imaging **PD -** Radiocarbon dating of the Shroud of Turin places it at 728 years old (in 2019). Is this definitive proof that it was not used as a burial cloth for Jesus? Chernobyl – was it right for the army to be sent in to clean up – fatal dose of radiation? *UV radiation and the risks of skin cancer from the sun and sun beds.* Camera/eye/contact lenses uses refraction Periscope of submarine uses reflection

	• Recall some nuclei are unstable and may emit, alpha, beta, neutrons or gamma radiation and relate these emissions to change in mass or charge of the nucleus. • Recall difference in penetration of different types of radiation. • Recall the difference between contamination and irradiation and the hazards associated. • Write balanced symbol equations to represent radioactive decay. • Explain how absorption and emission of EM radiation can change the position of electrons around the atom. • Explain the concept of half-life and how it is related to the random nature of radioactive decay. • **Calculate the net decline, expressed as a ratio, after a given number of half-lives.** Use of a Geiger-Muller tube and radioactive sources to investigate activity Use a model to represent random decay and half-life Golden thread – particles and energy					Marie Curie and the important work she did for radioactivity and what happened to her because of its ionising properties. Radioactive tracers in medicine and in industry

B4 Community Level systems	<u>Ecosystems</u>
	• Recall that many different materials cycle through biotic and abiotic factors, including microorganisms. To include:
	  • Carbon Cycle
	  • Water Cycle
	  • Nitrogen Cycle
	• Describe different levels of organisation on an ecosystem.
	• Explain the importance of the carbon cycle and water cycles to living organisms.
	• Explain how abiotic and biotic factors can affect communities.
	• Describe the interdependent relationships in an ecosystem to include:
	  • Predation
	  • Mutualism
	  • Respiration
	
	Golden thread – particles and interdependence
		Recall of content
		Drawing and interpreting graphs
		Using models to explain scientific ideas
		Data analysis
			Plot and draw appropriate graphs selecting appropriate scales for the axes.
			
			Extract and interpret information from charts, graphs and tables.
				Within biology units so far student have explored from cells up to the whole organism: Ecosystems now provides the platform for students to discuss the interaction between organisms. This builds on concepts such as food chains and webs first explored in Phase 1. Students will also need to revisit a plethora of skills already developed such as calculating percentage change, substituting and solving equations as well as plotting and interpreting graphs. The processes explored up to this stage, for example photosynthesis and respiration, will now be revisited to look for links between the two.	Mutualism
					Biotic
					Abiotic
						PD - Impact on ecosystems - deforestation, greenhouse gas.
						
						CC - Intensive farming vs. organic in terms of nutrient recycling and global warming.
						
						Careers – Ecologist, conservationist, park ranger, marine biologist, hydrologist, plant breeder, agricultural researcher.

C5 Monitoring and Controlling chemical reactions	<u>Controlling Reactions</u> • Suggest practical methods for determining the rate of a given reaction and interpret rate of reaction graphs. • Describe effects of changes in temperature, concentration, pressure and surface area on rate of reaction. • Explain effects on rate of reaction of changes in temperature, concentration, pressure and surface area. • Explain effect on rate of reaction of changes in size of particles in a solid linked to surface area to volume ratio. • Describe the characteristics of catalysts and their effect on reaction rates, identify catalysts in reactions, and explain catalytic action in terms of activation energy and pathways.	Recall of content Presenting and collecting data, plan for variables, drawing conclusions, discussing limitations, analysing patterns, evaluating risks, justifying opinions, evaluating methods Using models to explain scientific ideas Data analysis	Arithmetic computation, ratio when measuring rates of reaction. Drawing and interpreting appropriate graphs from data to determine rate of reaction. Determining gradients of graphs as a measure of rate of change to determine rate. Proportionality when comparing factors affecting rate of reaction Reading off scales (volumes).	Monitoring and controlling rates of reaction draws together concepts from all chemistry units so far. Students need an understanding of the states of matter, what happens during a reaction, and be able to construct and mathematically interpret balanced symbol equations. These skills will be further extended when students explore how factors affecting the rate of reaction can be manipulated in order to produce the maximum yield. Students will develop several new practical skills, such as using a gas syringe or inverted measuring cylinder in a water trough in order to determine the volume of gas produced in an experiment.	Concentration Rate Temperature Catalyst Activation energy	**Careers - Chemical** Engineering, laboratory technician, process engineer. **PD - cars**- catalytic convertors, **CC -** Why do airbags require a fast rate of reaction? When is custard dangerous?

	• Recall that enzymes act as catalysts in biological systems. Disappearing Cross Investigating the effect of surface area on rate of reaction Investigating the effect of temperature on the rate of reaction Investigating the effect of catalysts on the rate of reaction Golden thread – energy and particles <u>Equilibria</u> • Recall that some reactions may be reversed by altering the reaction conditions. • Recall that dynamic equilibrium occurs in a closed system when the rate of the forward and reverse reactions are equal. • **Predict the effect of changing reaction conditions on equilibrium position and suggest appropriate conditions to produce as much of a particular product as possible. (Le Chatelier's principle)** Golden thread – energy and particles		Use of positive and negative values to determine overall energy change. Interpreting graph relating to reaction rate.			
P5 Energy	<u>Work Done</u> • Give a qualitative description of the conservation of energy and identify energy stores and transfer pathways in a given situation. (in a closed system link to conservation of energy) • Describe and calculate energy changes in: ○ Heating relating to the SHC of substances ○ Work done by a force $WD = F \times d$ ○ Work done electrically $E = P \, x \, t$. • Calculate energy transferred by devices and calculate the cost of use. • Calculate energy stored: ○ Gravitationally $GPE = m \times g \times h$ ○ Kinetically $KE = 0.5 \times m \times v^2$ ○ Elastically $EE = 0.5 \times k \times x^2$ ○ Thermally $E = m \times SHC \times \Delta T$ Golden thread – forces and energy <u>Power and Efficiency</u> • Describe how energy can be dissipated • Describe how energy is transferred from batteries and from the mains • Calculate the efficiency of energy transfer • **Describe ways to increase efficiency.** • Explain ways to reduce unwanted energy transfer. • Describe the rate of cooling and define thermal conductivity.	Recall of content Presenting and collecting data, plan for variables, drawing conclusions, discussing limitations, analysing patterns, evaluating risks, justifying opinions, evaluating methods Using models to explain scientific ideas Data analysis.	Expressions in decimal form and give values to an appropriate number of significant figures when changing the subject of equations and substituting into all energy transfer and energy store equations. Expressions in decimal form and give values to an appropriate number of significant figures when changing the subject of equations and substituting into the efficiency equation.	In the Energy unit students start by revisiting the energy stores first explored in year 8 and calculated in Matter and Forces. The knowledge is extended by asking students to analyse situations to identify the stores energy transfers between, and to establish the transfer pathway. Students will be expected to calculate the work done to transfer between stores and total amounts of energy stored. Students will also have the opportunity to develop an understanding of how electricity bills work, which will provide an insight for some which they may not otherwise experience.	**Dissipate** **Specific Heat Capacity** **Potential** **Kinetic** **Conservation** **Equilibrium**	**Careers -** Engineering – building turbines, solar panels, civil engineering, energy providers. **PD -** Should we be moving faster to renewable resources? Should homeowners be forced to insulate or install solar panels? Cost of power – bills and budgeting.

	Golden thread - energy					
B5 Genes, Inheritance and selection	Natural Selection and Evolution • Recall most species have a wide variation within their species. • Describe the development of classification: artificial vs natural. • *Explain that natural selection leads to evolution as variants give rise to phenotypes better suited to the environment.* • Describe evolution as the change in inherited characteristics over time, which could lead to the formation of a new species. • **Describe how the fossil record and antibiotic resistant bacteria provides evidence for evolution** • **Explain how scientific advances have led to the development of the natural classification system** Golden thread – cells and interdependence	Recall of content. Using models to explain scientific ideas. Understanding how scientific ideas change over time. Data analysis. Exam technique, specifically practicing writing extended pieces (6 mark questions).	Extract and interpret information from charts, graphs and tables.	Students will explore how the development in technology has led to greater understanding of how organisms are related to one another. Opportunities naturally arise to discuss the probability of evolution vs intelligent design argument. Ideas are explored mathematically and prior mathematical skills such as ratios, fractions and percentages are revisited.	Inheritance Allele Gene Homozygous Heterozygous Dominant Recessive	PD -Creationism vs evolution – why might there be disagreements between the church and scientists
C6 Global Challenges	Improving processes and products • Explain the extraction of metals from the earth including those found in ores and those found native linked to their position in relation to carbon in the reactivity series. • **Evaluate biological extraction of metals.** • Describe the basic principles in carrying out a life-cycle assessment of a material or product. • Interpret data from life cycle assessment. • Evaluate factors affecting decisions on recycling. • Describe and explain the separation of crude oil by fractional distillation; describe the fractions as a mixture of members of the alkane homologous series. • Recall that crude oil is a main source of hydrocarbons and is a feedstock for the petrol chemical industry and modern life is crucially dependent on the fractions. • Define the terms fraction and crude oil. • Describe the production of more useful products with the process of cracking. Purification of copper using electrolysis Golden thread - particles Interpreting and Interacting with Earth Systems • Describe the composition of the atmosphere and interpret evidence for how it was thought to have formed. • Describe the greenhouse effect in terms of the interaction of radiation with matter within the atmosphere.	Recall of content Presenting and collecting data, plan for variables, drawing conclusions, discussing limitations, analysing patterns, evaluating risks, justifying opinions, evaluating methods Using models to explain scientific ideas Data analysis	Extract and interpret information from charts, graphs and tables in relation to changes in greenhouse gases and pollutants. Use orders of magnitude to evaluate the significance of data.	Global Challenges explores the impact of human activity on the Earth. Concepts first encountered in year 7 and 8 are revisited such as our Earth as a source of materials and the importance of recycling in preserving finite resources. This knowledge is extended by looking at the different ways' materials are extracted, and the impact using these resources can have on the environment, specifically on the climate. Throughout delivery of the unit the importance of recycling in preserving finite resources is emphasised, and the bigger picture consequences in terms of preserving clean water and fossil fuels by reducing energy consumption.	Alkane Alkene Cracking Fraction Hydrocarbon Ore	**Careers** Material scientist. Geologist. Product development formulation scientist. Energy, oil and gas jobs. Rig mechanic. Air pollution officer. Friends of the Earth campaign lead. Environmental officer. Water hygiene engineer. **PD** Morality of using land for crops (phytomining) rather than using the land for crops to help with world starvation. Recycling materials – impact on the environment. Oil extraction – producing wealth. Geology – using local people to help extract metals.

	• Evaluate the evidence for anthropogenic causes of climate change and uncertainties in the evidence base. Describe potential effects of increased levels of greenhouse gases on the atmosphere. • Describe sources of major pollutants and explain the problems they cause. • Describe the principal methods for increasing the availability of potable water. Golden thread - interdependence					
P6 Global Challenges	<u>Physics on the Move</u> • Recall typical speeds encountered in everyday life and estimate the magnitude of accelerations. Calculations may involve a change of unit. • Explain methods of measuring human reaction times and typical results. • Explain the factors affecting a vehicles ability to come to a complete stop, and the dangers of large decelerations in emergencies. Investigation of reaction time Golden thread - forces <u>Powering Earth</u> • Describe the main energy sources, renewable and non-renewable, and compare how they are used. • Explain trends and patterns in the use of energy sources. • Recall the role of the national grid, including the specific role of transformers in efficient energy transfer. • Recall the domestic supply in the UK is a.c. at 50 HZ and 230 V. • Explain the difference between direct and alternating voltage. • Recall the differences in function between the live, neutral and earth mains wires, and the potential differences between these wires • Explain the dangers of providing a connection between a live and earth wire. Wiring of a plug Golden thread - energy	Recall of content Presenting and collecting data, plan for variables, drawing conclusions, discussing limitations, analysing patterns, evaluating risks, justifying opinions, evaluating methods Using models to explain scientific ideas Data analysis	Converting units before carrying out calculations. Use fractions, make estimates, construct diagrams, convert units, change the subject of equations and substitute values into equations for everyday speeds and accelerations. Expressions in decimal form and give values to an appropriate number of significant figures when changing the subject of equations and substituting into the transformer equation.	The final unit, On the move and energy resources draws together all learning so far in five-year curriculum journey. It discusses the problems which face the human race in terms of a secure energy supply, and what we can do to extend the use of potentially finite resources. Students are expected to apply equations first encountered in Forces to situations relevant to road transport in everyday life. Students will also develop an understanding of how the electricity we rely on in school and at home is generated and transferred to point of use.	Renewable Non-renewable Braking distance	**Careers –** Traffic control safety officer, advanced automotive designer, hydropower / renewable energy engineer, UK sales manager oil and gas, assistant technical electrician, electrical service engineer, National Grid Engineer. ***PD-*** *The implications of drugs and alcohol on road safety.* **PD -** Should we be moving faster to renewable resources? Should homeowners be forced to insulate or install solar panels? Cost of power – bills and budgeting
B6 Global Challenges	<u>Monitoring and Maintaining the Environment</u> • Explain how to carry out a field investigation into the distribution and abundance of organisms. • Describe positive and negative consequences of human activity on biodiversity. • Explain challenges faced in maintaining local and global biodiversity. Identification of abiotic factors using sampling techniques Golden thread - interdependence	Recall of content Presenting and collecting data, plan for variables, drawing conclusions, discussing limitations, analysing patterns, evaluating risks, justifying opinions, evaluating methods	Calculate arithmetic means Plot and draw appropriate graphs selecting appropriate scales for the axes, extract and interpret information. Understand and use percentiles. Understand the principles of sampling as applied to scientific data.	Global Challenges ties together all branches of biology which have been explored throughout the five-year curriculum journey so far. *Students will look at the distribution of organisms, specialised cells within organisms which defend against disease, The interaction of pathogens and how our understanding of the genome and development of technology will allow for specific changes to organisms to either provide stable food sources or to improve the efficacy of medicines. The impact of lifestyle choices such as diet and exercise will be explored in terms of the impact on the instances of non-communicable diseases. Students will be asked to interpret data to*	Communicable Non-communicable Biodiversity Transect Quadrat Abundance Distribution	PD & RSHE - The ethical implications of selective breeding and reducing the genome. Do benefits to supplying food outweigh possible increased birth defects and vulnerability to disease? RSHE - Self-examination for cancer. Healthy lifestyles. PD - Cultural differences in how animals like tigers or elephants are

	Feeding the Human Race • *Explain the impact of selective breeding on organisms.* • *Describe genetic engineering as a process which involves modifying the genome and* ***describe the main steps.*** • Explain the possible benefits and risks of using technology in modern agriculture. Golden thread – cells and interdependence Monitoring and Maintaining Health • *Describe the difference between health and diseases, different types of diseases and how they can interact.* • *Explain how communicable diseases in plants and animals spread and explain how the spread can be reduced or prevented (HIV/AIDS and Agrobacterium tumerfaciens).* • *Explain how white blood cells and platelets are adapted to their defence functions.* • *Describe the non-specific defence systems of the human body against pathogens.* • *Explain the role of the immune system in defence against disease.* • *Explain the use of medicines and vaccines in the prevention and treatment of disease.* • *Describe the processes of discovery and development of new medicines.* • *Recall that many non-communicable diseases are caused by an interaction of a number of factors and analyse the effect of lifestyle factors on the incidence of non-communicable diseases at local, national and global levels.* • *Evaluate some treatments of cardiovascular disease.* • *Describe cancer as a result of changes in cells that lead to uncontrolled growth and division.* • *Discuss potential benefits and risks of use stem cells.* • *Explain possible benefits and risks of gene technology.* • *Discuss the potential importance of increasing the understanding of the human genome in medicine.* Investigation into the growth of bacterial cultures using aseptic technique Golden thread - cells	Using models to explain scientific ideas Data analysis	Extract and interpret information from charts, graphs and tables. Translate information between graphical and numerical forms. Construct and interpret frequency tables and diagrams, bar charts and histograms. Understand the principles of sampling as applied to scientific data. Use a scatter diagram to identify a correlation between two variables. Calculate cross-sectional areas of bacterial cultures and clear agar jelly using πr^2.	*understand that medical treatments of some non-communicable diseases are only successful in combination with improved lifestyle. This links to prior learning in year 7 of the importance of a healthy diet.* Students will continue to develop practical skills, in terms of sampling techniques. Students will also consolidate many mathematical skills in terms of arithmetic calculations, interpreting and extracting data and calculating areas.		dealt with e.g. pest or protected species, e.g. whales and Japan. PD & RSHE - The use of gene technology in treatment of disease and securing food supply. Do we have the right to play God? Are there any unforeseen implications? SSSI: Sites of special scientific interest – nature reserves, national parks. PD & RSHE - Antivaccination debate. PD & RSHE - Ethics of drug trials. PD & RSHE - Applications of embryonic stem cells and ethics of using them. PD & RSHE - Non-communicable diseases if caused by lifestyle choices should they get NHS treatment for free?