GRACE COLLEGE **Curriculum Outline Year 10** **Science**

Year 10 Curriculum Intent

"Students will learn...a broad and informative curriculum that encompasses the key concepts of biology, chemistry and physics and how they link together to allow students to enjoy the awe and wonder of Science.
Students will be able to...deploy their scientific literacy and skills effectively, enabling them to not only think critically but also engage as informed citizens in scientific discussions, and recognize the value of science when making informed decisions; ultimately contributing as functional members of society."
Students will become...appreciative of the world around them, how it works, where it began and the impact they can have on it - all while being prepared for further study and employment in scientific fields, achieving their personal best regardless of their background".

Year 10 Curriculum Overview

Half term 1	Half term 2	Half term 3	Half term 4	Half term 5	Half term 6
P2 Electricity B2 Organisation P3 Particle Model of Matter B3 Infection and Response	C4 Chemical Changes B4 Bioenergetics C5 Energy Changes	P4 Atomic Structure C3 Quantitative Chemistry	Revision Annual Exams	C9 Atmosphere P5 Forces	B7 Ecology C6 Rates of Reaction P6 Waves

Key Question

What happens in electrical circuits? How do we use electricity in the home? How are systems organised in the body to carry out life processes? How does the particle model predict the behaviour of solids, liquids and gases? What causes disease and how does the body defend itself against it?	What are the reactions of metals and acids? How does electrolysis work? What are photosynthesis and respiration? What are the energy changes in chemical reactions?	What are the properties, uses and dangers of nuclear radiation? How do Chemists use quantitative analysis to determine the formulae of compounds and the equations for reactions? How do we determine the purity of chemical samples and to monitor the yield from chemical reactions?	How am I doing so far and what can I do to make myself even better?	How is the Earth's atmosphere changing? How do forces affect the motion of objects?	How do the species in ecosystems depend on each other? What factors affect the rate of chemical reactions and equilibrium? What are the properties and uses of different types of waves?

Key Vocabulary

Charge, current, potential difference, resistance, series, parallel, power, National Grid, transformers Digestive system, enzymes, heart, artery, capillary, vein, lungs, blood, coronary heart disease, non-communicable, cancer Particles, internal energy, latent heat, specific heat capacity, density Communicable, bacteria, virus, fungi, protist, immune system, vaccination, antibody, antibiotics	Metal extraction, reactivity series, redox, neutralisation, electrolysis Photosynthesis, palisade, stomata, xylem, phloem, transpiration, aerobic, anaerobic, respiration, metabolism Endothermic, exothermic, reaction profile, activation energy, bond energy	Atom, isotope, decay, alpha, beta, gamma, ionising, half-life, contamination, irradiation Conservation, relative formula mass, mole, Avogadro's constant, limiting reactant, concentration	Progress, Growth Mind Set, Resilience, Reflective, Improvement	Atmosphere, greenhouse gases, climate change, carbon footprint, pollutant Force, Scalar, Vector, Acceleration, Newtons Laws, Terminal Velocity, Momentum, Work Done, Extension, Moments, Pressure, Weight, Resultant Force	Species, habitat, community, ecosystem, biotic, abiotic, quadrat, transect, adaptation, interdependence, biodiversity, deforestation Rate, Reaction, Reactant, Product, Equilibrium, Collisions, Temperature, Catalyst, Pressure, Surface Area, Reversible Vibrations, transverse, longitudinal, wavelength, frequency, oscillate electromagnetic spectrum, infrared radiation

Biology Chemistry Physics

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CORE KNOWLEDGE

Year 10 – SCIENCE HALF TERM 1 (1)

	The knowledge you will need know:	How you will apply this knowledge:	This links to:
1	**P2 Electricity** • Standard circuit symbols for components • Current is a flow of charge • For a current to flow there must be a source of potential difference • Recall the equation for charge • The effect of resistance on current. • Recall the equation V=IR • Identify IV characteristics for fixed resistor, filament lamp and diode. • How resistance of LDR and thermistor changes with different conditions. • Applications of LDRs and thermistors. • The rules for current, potential difference and resistance in series and parallel circuits. • Mains electricity is an ac supply. In the United Kingdom the • domestic electricity supply has a frequency of 50 Hz and is about 230 V. • The colour, position and function of the wires in a three core cable. • Recall both equations for power. • Recall the equations for energy transferred by electrical work • Identify parts of the National Grid. • State the role of the Step up and Step down transformers.	• Draw and interpret circuit diagrams. • Apply the equation to calculate charge. • Use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. • Use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements • Describe the relationships shown by IV characteristics. • Explain the design and use of a circuit to measure the resistance of a component by measuring the current through, and potential difference across, the component. • Describe the difference between series and parallel circuits • Calculate the currents, potential differences and resistances in dc series circuits. • Explain the difference between direct and alternating potential difference. • Label a diagram of a plug and identify and mistakes in wiring. • Explain the safety features of a plug. • Explain the dangers of providing any connection between the live wire • and earth. • Apply the equations to calculate power. • Describe how different domestic appliances transfer energy from batteries or ac mains to the kinetic energy of electric motors or the energy of heating devices. • Apply the equations to calculate energy transferred. • Describe, with examples, the relationship between the power ratings for domestic electrical appliances and the changes in stored energy when they are in use. • Explain why the National Grid system is an efficient way to transfer energy.	P7: Magnetism and electromagnetism
2	**B2 Organisation** • The human digestive system breaks down food into small soluble molecules absorbed into the blood, while the respiratory system provides oxygen and removes carbon dioxide; both rely on the circulatory system to transport substances quickly. • Damage to these systems can be severe and can be prevented by lifestyle choices. • Cells form tissues, tissues form organs, organs form organ systems, which together make up organisms. • Enzymes in digestion (amylase, proteases, lipases) catalyse the breakdown of carbohydrates, proteins, and fats. Enzyme activity depends on factors like temperature and pH. • The heart pumps blood in a double circulatory system, with arteries, veins, and capillaries adapted for their specific functions. • Blood consists of plasma, red and white blood cells, and platelets • Coronary heart disease involves narrowing arteries, treatable by stents, statins, and sometimes transplants or artificial hearts. • Health is influenced by disease, lifestyle, diet, stress, and interactions between different diseases. • Risk factors such as smoking, diet, alcohol, and carcinogens increase the incidence of non-communicable diseases including cancer. • Cancer results from uncontrolled cell growth; tumours can be benign or malignant. • Plants have tissues (epidermis, mesophyll, xylem, phloem) adapted for functions like water and nutrient transport. • Transpiration and translocation move water, minerals, and sugars in plants, influenced by environmental conditions like temperature and humidity.	•Explain how enzyme activity can be affected by changes in temperature and pH using the lock and key model. •Interpret experimental data to determine the rate of enzyme-catalysed reactions, such as starch digestion by amylase. •Describe how the structure of the heart and blood vessels relates to their function in the circulatory system. •Explain how lifestyle factors like diet, smoking, and exercise influence the risk of developing non-communicable diseases. •Evaluate different treatments for coronary heart disease, considering their advantages and risks. •Interpret graphs or tables showing the incidence of diseases and correlate this with risk factors such as smoking or diet. •Describe how plant tissues (xylem and phloem) are adapted to transport water and nutrients efficiently. •Explain how environmental conditions (temperature, humidity, light) affect the rate of transpiration in plants. •Use microscope images to identify and explain the function of different blood cells or plant tissues. •Analyze data from practical investigations such as transpiration rate experiments or enzyme activity tests to draw conclusions.	Year 7 Organisms: Cells Year 8 Organisms: Digestion Ecosystems: Photosynthesis Organisms: Breathing and Respiration Year 10: B4 Bioenergetics Year 11: B5 Homeostasis and response

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CORE KNOWLEDGE

Year 10 – SCIENCE HALF TERM 1 (2)

	The knowledge you will need know:	How you will apply this knowledge:	This links to:
3	**P3 Particle Model of Matter** • State the arrangement and movement of particles in solids liquids and gases. • Identify changes of state • Know that changes of state are physical changes • Define internal energy. • What happens to a substance when it is heated in terms of energy. • Define specific heat capacity. • Define specific latent heat. • What causes pressure in gases.	• Recognise/draw simple diagrams to model the difference between solids, liquids and gases. • Explain the differences in density between the different states of matter in terms of the arrangement of atoms or molecules. • Select and apply the equation for specific heat capacity. • Select and apply the equation for specific latent heat. • Interpret heating and cooling graphs that include changes of state. • Distinguish between specific heat capacity and specific latent heat. • Explain how the motion of the molecules in a gas is related to both its temperature and its pressure. • Explain qualitatively the relation between the temperature of a gas and its pressure at constant volume.	Year 7: Matter Particle Model Matter: Separating Mixture Year8 Energy: Heating and Cooling Year 10: P5: Forces
4	B3 Infection and Response • The nature of pathogens and how they spread and cause symptoms. • The causes, symptoms, spread and treatment of: measles, HIV, TMV, salmonella, gonorrhoea, rose black spot, malaria. • Describe the non-specific defence systems of the human body against pathogens explain the role of the immune system in the defence against disease. • Recall how vaccines work in creating immunity in individuals. • Describe how drugs are developed and used including antibiotics. • TRIPLE: Know common features of plan deficiencies and diseases and how plants defend themselves.	• Explain how diseases caused by viruses, bacteria, protists and fungi are spread in animals and plants. Explain how the spread of diseases can be reduced or prevented. • Explain how vaccination will prevent illness in an individual, and how the spread of pathogens can be reduced by immunising a large proportion of the population. • Explain the use of antibiotics and other medicines in treating disease. • Describe the process of discovery and development of potential new medicines, including preclinical and clinical testing. • TRIPLE: Describe how monoclonal antibodies are produced and used. • TRIPLE: Explain how plant diseases and deficiencies can be detected and describe physical and chemical plant defence responses.	Year 7: Organisms Cells Year 9: Organisms: Microbes, Disease and Immune System Year 10 B7 Ecology

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CORE KNOWLEDGE

Year 10 – SCIENCE HALF TERM 2 (1)

	The knowledge you will need to recall:	How you will apply this knowledge:	**This links to:**
1	**C5 Energy Changes** •**Energy changes occur in chemical reactions** due to breaking and forming bonds. •**Exothermic reactions** release energy to the surroundings (temperature rises), e.g., combustion and neutralisation. •**Endothermic reactions** absorb energy from the surroundings (temperature falls), e.g., thermal decomposition and some sports injury packs. •**Reaction profiles** show energy changes during a reaction, including activation energy and whether the reaction is exothermic or endothermic. •Breaking bonds requires energy; forming bonds releases energy. The overall energy change depends on these bond energies. •**Chemical cells** generate electricity from reactions between electrodes and electrolytes; batteries are multiple cells connected together. •**Rechargeable batteries** can be recharged as reactions are reversible, unlike non-rechargeable types. •**Fuel cells** use hydrogen and oxygen to produce electricity and water, offering a cleaner alternative to batteries.	•Explain whether a reaction is exothermic or endothermic based on temperature changes during the reaction. •Draw and interpret reaction profiles to identify activation energy and overall energy change. •Use bond energy data to calculate the energy released or absorbed in a reaction. •Evaluate practical applications of exothermic and endothermic reactions, such as hand warmers or cold packs. •Describe how chemical cells and batteries produce electricity and explain the difference between rechargeable and non-rechargeable cells. •Interpret data comparing the voltage produced by different cells based on electrode and electrolyte types. •Assess the advantages and disadvantages of hydrogen fuel cells compared to conventional batteries. •(Higher Tier) Write half-equations for the reactions occurring in hydrogen fuel cells. •Design or evaluate experiments to measure temperature changes in reacting solutions to determine if reactions are exothermic or endothermic.	Year 7: Matter Particle Model Matter: Separating Mixtures Year 8: Matter: Elements Matter: Periodic Table Year 9: Matter Bonding Year 9: C1 Atomic Structure and Periodic Table Year 10: C2: Bonding C3: Quantitative C4: Chemical Changes C6: Rates Year 11: C8 Chemical Analysis
2	**C4 Chemical Changes** • Metals react with oxygen to produce metal oxides. • What an oxidation and reduction are in terms of oxygen and electrons. • Metal atoms form positive ions. • The order of reactivity of metals. • What a displacement reaction is. • Unreactive metals exist as the metal itself, but most exist as compounds that are extracted using chemical reactions. • Metals less reactive than carbon can be extracted from their oxides by reduction with carbon. • Acids react with some metals to produce salts and hydrogen. • To state what happens in neutralisation reactions. • Identify the names of salts produced in neutralisation reactions. • The ions produced by acids and aqueous solutions of alkalis. • State the pH of an acid, alkali and neutral solution. • State ways of measuring pH. • State what strong and weak acids are. • State how pH changes when concentration changes. • Identify equipment needed for electrolysis. • Identify the products of electrolysis at the cathode and anode. • State that electrolysis can be used to extract metals from molten compounds. • Aluminium is extracted using electrolysis of aluminium oxide. • State the products from electrolysis of aqueous solutions. • State where oxidation and reduction occur in electrolysis.	• Explain reduction and oxidation in terms of loss or gain of oxygen. • Describe the reactions of metals with water and dilute acids. • Explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ion • Deduce an order of reactivity of metals based on experimental results. • Identify the substances which are oxidised or reduced in terms of gain or loss of oxygen. • Describe how to make pure, dry samples of named soluble salts from information provided. • Predict products from given reactants • Use the formulae of common ions to deduce the formulae of salts. • Describe the use of indicators to measure the approximate pH of a solution. • Use the pH scale to identify acidic or alkaline solutions. • Explain the terms dilute and concentrated and weak and strong in relation to acids. • Describe neutrality and relative acidity in terms of the effect on hydrogen ion concentration and the numerical value of pH. • Describe the process of electrolysis. • Predict the products of the electrolysis of binary ionic compounds in the molten state. • Explain why electrolysis is used to extract metals based on reactivity. • Explain why a mixture with cryolite is used as the electrolyte. • Investigate, including developing a hypothesis what happens when aqueous solutions are electrolysed. • Represent the reactions at electrode using half equations.	Year 7: Matter Particle Model Matter: Separating Mixtures Year 8: Matter: Elements Matter: Periodic Table Year 9: Matter Bonding Year 9: C1 Atomic Structure and Periodic Table Year 10: C2: Bonding C3: Quantitative C5: Energy Changes C6: Rates Year 11: C8 Chemical Analysis C10 Using Resources

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CORE KNOWLEDGE

Year 10 – SCIENCE HALF TERM 2 (2)

	The knowledge you will need to recall:	How you will apply this knowledge:	**This links to:**
3	**B4 Energetics** • Recall the word and balanced symbol equation for photosynthesis. • Explain the effects of temperature, light intensity, carbon dioxide concentration, and the amount of chlorophyll on the rate of photosynthesis. • State the uses of glucose produced in photosynthesis. • Recall the word and balanced symbol equation for aerobic respiration. • Recall the word equations for anaerobic respiration in yeast and animal cells and the effects and uses of these reactions. • Explain the effect of exercise on the body in terms of respiration and oxygen debt. • Understand metabolism as the is the sum of all the reactions in a cell or the body and recall metabolic reactions.	• Describe photosynthesis as an endothermic reaction in which energy is transferred from the environment to the chloroplasts by light. • Measure and calculate rates of photosynthesis • Investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed. • HT: use inverse proportion – the inverse square law and light intensity in the context of photosynthesis. • HT: Understand limiting factors are important in the economics of enhancing the conditions in greenhouses to gain the maximum rate of photosynthesis while still maintaining profit. • Describe cellular respiration as an exothermic reaction which is continuously occurring in living cells. • Compare the processes of aerobic and anaerobic respiration with regard to the need for oxygen, the differing products and the relative amounts of energy transferred. • HT: Explain oxygen debt. • Explain the importance of sugars, amino acids, fatty acids and glycerol in the synthesis and breakdown of carbohydrates, proteins and lipids.	Year 7 Organisms: Cells Year 8 Ecosystems: Photosynthesis Organisms: Breathing and Respiration Year 10: B2 Organisation

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CORE KNOWLEDGE

Year 10 – SCIENCE HALF TERM 3

	The knowledge you will need to recall:	How you will apply this knowledge:	This links to:
1	**P4 Atomic Structure** • State the radius of the atom and nucleus. • The basic structure of an atom. • State that in an atom the number of electrons is equal to the number of protons in the nucleus. • What atomic number is. • What mass number is. • What an isotope is. • That the model of the atom has changed over time with new experimental evidence. • What nuclear decay is and that it is a random process. • What activity is and the unit for activity. • What count rate is and what we use to measure it. • State what alpha, beta, gamma and neutron radiation is made up of. • Know how alpha and beta particles are represented in nuclear equations. • Define half life. • State what contamination and irradiation is. • State hazards presented by radioactive sources and suitable precautions that can be taken. • Understand that findings on risk of radiation should be checked by peer review.	• Label a diagram of the atom. • Explain how electron arrangements may change • Identify number of protons, neutrons and electrons from mass and atomic numbers. • Describe why the new evidence from the scattering experiment led to a change in the atomic model. • Describe the difference between the plum pudding model of the atom and the nuclear model of the atom. • Describe the properties of alpha, beta and gamma in terms of range in air, penetration through materials and ionising power. • Apply knowledge to the uses of radiation and evaluate the best sources of radiation to use in a given situation. • Use the names and symbols of common nuclei and particles to write balanced equations that show single alpha (α) and beta (β) decay. • Describe how mass and charge changes during nuclear decay. • Explain the concept of half-life and how it is related to the random nature of radioactive decay. • Determine the half-life of a radioactive isotope from given information. • Compare the hazards associated with contamination and irradiation. • Describe the process of peer review.	C1 Atomic structure P6 Waves
2	**C3 Quantitative Chemistry** • Know the law of conservation of mass. • Know what Relative formula mass is. • Know that Some reactions may appear to involve a change in mass but this can usually be explained because a reactant or product is a gas and its mass has not been taken into account. • Know how to calculate a mean. • Know how to find the range of a set of results. • Know how to find the uncertainty of a data set. • Know what a mole is and the units. • Know how to find the mass of one mole. • State Avogadro's constant. • Know what concentration is and the units. • Recall the equation to calculate concentration.	• Use the conservation of mass to balance symbol equations. • Calculate Relative formula mass. • Calculate the percentage by mass in a compound given the relative formula mass and the relative atomic masses. • Explain any observed changes in mass in non-enclosed systems during a chemical reaction given the balanced symbol equation for the reaction and explain these changes in terms of the particle model. • Represent the distribution of results and make estimations of uncertainty • Use the range of a set of measurements about the mean as a measure of uncertainty. • Use the relative formula mass of a substance to calculate the number of moles in a given mass of that substance and vice versa • Calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution.	C4: Chemical changes, # C5 Energy changes, C6 The rate and extent of Chemical change

GRACE COLLEGE
CORE KNOWLEDGE

Year 10 – SCIENCE HALF TERM 4

	The knowledge you will need to recall:	How you will apply this knowledge:	**This links to:**
1	**Revision** **Understanding of all previous units for study found on Paper 1 exams**	• Exam questions during annual exams	All previous units

GRACE COLLEGE
CORE KNOWLEDGE

Year 10 – SCIENCE HALF TERM 5

	The knowledge you will need to recall:	How you will apply this knowledge:	This links to:
1	**C9 Atmosphere** • The Earth's atmosphere is mostly nitrogen (~80%) and oxygen (~20%), with small amounts of other gases like carbon dioxide and water vapor. • The early atmosphere was very different, mostly carbon dioxide with little or no oxygen, formed mainly by volcanic activity. • Oxygen levels increased over billions of years due to photosynthesis by algae and plants. • Carbon dioxide decreased as it dissolved in oceans and formed sedimentary rocks, fossil fuels, and carbonates. • Greenhouse gases such as water vapor, carbon dioxide, and methane trap heat, keeping Earth warm enough for life. • Human activities increase greenhouse gases, mainly carbon dioxide (e.g., burning fossil fuels) and methane (e.g., agriculture). • Increased greenhouse gases contribute to global climate change, which has wide-ranging environmental impacts. • The carbon footprint measures the total greenhouse gas emissions of a product, service, or event, and efforts exist to reduce it. • Burning fuels releases pollutants including carbon monoxide (toxic), sulfur dioxide and nitrogen oxides (cause acid rain and respiratory issues), and particulates (cause global dimming and health problems).	•Use given data to calculate or interpret the percentage composition of gases in the atmosphere. •Evaluate different scientific theories and evidence about the formation and evolution of Earth's atmosphere. •Explain how photosynthesis led to increases in atmospheric oxygen and decreases in carbon dioxide. •Describe and interpret the greenhouse effect and explain the role of greenhouse gases. •Identify human activities that increase carbon dioxide and methane emissions and explain their environmental impacts. •Assess the reliability and quality of evidence relating to global climate change and distinguish between peer-reviewed science and media speculation. •Discuss potential effects of global climate change on the environment and human society. •Suggest and justify actions to reduce carbon footprints and reduce greenhouse gas emissions. •Predict the products of combustion of fuels based on their composition and reaction conditions. •Explain the formation and harmful effects of common atmospheric pollutants such as carbon monoxide, sulfur dioxide, nitrogen oxides, and particulates. •Analyze the environmental and health risks associated with increased atmospheric pollutants.	Year 8 Earth: Climate C10 Using Resources
2	**P5 Forces** • **Forces:** Vector quantities; either contact (friction, tension) or non-contact (gravity, electrostatic, magnetic). • **Weight:** Force due to gravity; W=m×g • **Resultant Force:** Single force with same effect as all acting forces; • **Work Done:** Work Done =Force x Displacement; work transfers energy; friction converts work to heat. • **Elasticity:** Extension/compression proportional to force (Hooke's Law, F=ke) up to limit of proportionality; energy stored as elastic potential energy • **Moments:** Turning effect of force; moment = force × perpendicular distance; balanced moments equal clockwise and anticlockwise. • **Pressure:** P=f/a;; pressure in fluids increases with depth and density; upthrust explained by pressure difference. • **Scalar vs Vector:** Scalars (magnitude only, e.g., speed, distance), vectors (magnitude + direction, e.g., velocity, displacement, force). • **Motion:** Speed =distance/time ; velocity is speed + direction; acceleration=change in velocity/time; equations for uniform acceleration • **Newton's Laws:** • 1st Law: Object remains at rest or constant velocity if resultant force zero. • 2nd Law: F=ma. • 3rd Law: Equal and opposite forces between interacting objects. • **Stopping Distances:** Sum of thinking distance and braking distance; affected by speed, driver condition, and road/vehicle conditions. • **Momentum:** p=mv; momentum conserved in closed systems	•**Calculate weight:** Given mass and gravitational field strength, find weight force. •**Determine resultant forces:** Sum forces in one dimension; resolve forces into components for two dimensions. •**Calculate work done:** For forces causing displacement; analyze energy transfer and heat generation due to friction. •**Analyze elasticity:** Plot force-extension graphs; calculate spring constants; compute elastic potential energy stored in springs. •**Calculate moments:** Find unknown forces or distances for balanced objects; solve lever problems. •**Calculate pressure:** For forces on surfaces; pressure at different depths in fluids; analyze buoyancy and floating/sinking. •**Interpret motion data:** Use distance-time and velocity-time graphs to calculate speed, velocity, acceleration, and displacement. •**Apply Newton's laws:** Solve problems involving forces, acceleration, and motion changes; predict motion given forces. •**Evaluate stopping distances:** Estimate effects of speed, driver reaction time, and conditions on total stopping distance for safety assessments. •**Use momentum conservation:** Analyze collisions and explosions; calculate velocities before and after impact. •**Explain safety devices:** Airbags, seat belts, helmets reduce force by increasing impact time, lowering rate of change of momentum. •**Interpret vector diagrams:** Resolve forces; determine resultant forces in equilibrium and non-equilibrium cases.	Year 7 Forces: Speed Energy: Energy Transfers and Work Year 8: Forces: Gravity Year 9 Forces: Contact Forces Forces: Pressure Y11 P7 Magnetism and Electromagnetism

GRACE COLLEGE
CORE KNOWLEDGE

Year 10 – SCIENCE HALF TERM 6 (1)

	The knowledge you will need to recall:	How you will apply this knowledge:	This links to:
1	**B7 Ecology** • Describe different levels of organisation in an ecosystem from individual organisms to the whole ecosystem • Describe the importance of interdependence and competition in a community • Recall biotic and abiotic factors. • Explain how organisms are adapted to live in their natural environment, given appropriate information. • Explain how feeding relationships are represented in food chains and food webs. • Recall that many different materials cycle through the abiotic and biotic components of an ecosystem and explain the importance of the carbon and water cycles to living organisms. • TRIPLE: explain how temperature, water and availability of oxygen affect the rate of decay of biological material. • Describe the importance of biodiversity and explain the effect of both positive and negative human interactions on ecosystems. • TRIPLE: Describe the differences between the trophic levels of organisms within an ecosystem. Explain how biomass is lost between the different trophic levels. • TRIPLE: Describe some of the biological factors affecting levels of food security	• When provided with appropriate information suggest the factors for which organisms are competing in a given habitat and how organisms are adapted to the conditions in which they live. • Explain how a change in an abiotic/biotic factor would affect a given community given appropriate data or context. • Measure the population size of a common species in a habitat. Use sampling techniques to investigate the effect of a factor on the distribution of this species. • TRIPLE: investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change. • Evaluate the impact of environmental changes on the distribution of species in an ecosystem given appropriate information. • Describe some of the biological consequences of global warming. • Evaluate methods that can be used to tackle problems caused by human impacts on the environment • TRIPLE: Construct accurate pyramids of biomass from appropriate data. Calculate the efficiency of biomass transfers between trophic levels by percentages or fractions of mass. • TRIPLE: describe and explain some possible biotechnical and agricultural solutions, including genetic modification, to the demands of the growing human population.	Year 7: Organisms: Cells Genes: Variation and Classification Year 8: Ecosystems: Photosynthesis Ecosystems: Plant Reproduction Ecosystems: Interdependence Year 9: Genes: Evolution and Inheritance
2	C6 Rate of Reaction • **Rate of Reaction:** Calculated using Rate = Quantity of reactant used or product formed / Time Units can be g/s, cm^3/s, or mol/s (HT only). • **Measuring Rates:** Use mass loss or volume of gas formed. Rates can also be measured graphically using tangents on curves to find instantaneous rate. • **Factors Affecting Rate: Concentration** (higher = faster) **Pressure** (for gases; higher = faster)**Surface area** (smaller particles = faster **Temperature** (higher = faster **Catalysts** (increase rate by lowering activation energy) • **Collision Theory:** Particles must collide with sufficient energy (activation energy) to react. Rate depends on collision frequency and energy. • **Catalysts:** Speed up reactions without being used up and provide alternative pathway with lower activation energy. Enzymes are biological catalysts • **Reversible Reactions:** Products can react to form reactants. • **Energy in Reversible Reactions:** If forward is **exothermic**, reverse is **endothermic** and vice versa. Energy change is equal in both directions. • **Dynamic Equilibrium:** Occurs in a closed system when the forward and reverse reactions occur at the same rate. • **Le Chatelier's Principle (HT only):** A system at equilibrium will shift to counteract changes in conditions (temperature, pressure, concentration).	• **Calculate rate of reaction** using data from experiments (mass lost, volume of gas, moles formed). • **Draw and interpret graphs** of product/reactant vs. time; estimate instantaneous rate using tangent gradient. • **Design experiments** to test effect of factors like concentration or surface area on reaction rate (e.g. Required Practical 5). • **Predict changes in rate** using **collision theory** by discussing how frequency and energy of collisions are affected. • **Use reaction profiles** to compare catalysed and uncatalysed reactions and explain how catalysts affect activation energy. • **Recognise and write reversible reactions**, and identify exothermic/endothermic directions. • **Predict how equilibrium shifts** when conditions are changed, applying **Le Chatelier's Principle** to maximise product yield in industrial settings. • **Use stoichiometric equations** to count gas molecules and predict pressure effects on equilibrium (HT only). • **Interpret data tables or graphs** showing reaction progress or equilibrium changes under different conditions. • **Apply understanding of catalysts** to real-world examples (e.g. catalytic converters, enzymes in digestion). • **Optimize industrial reactions** (like the Haber process) by balancing rate, yield, cost, and energy efficiency.	

GRACE COLLEGE
CORE KNOWLEDGE

Year 10 – SCIENCE HALF TERM 6

	The knowledge you will need to recall:	How you will apply this knowledge:	This links to:
3	P6 Waves • **Types of Waves: Transverse waves** (e.g. water, light): oscillations are **perpendicular** to wave direction. **Longitudinal waves** (e.g. sound): oscillations are **parallel** to wave direction, featuring compressions and rarefactions. • **Waves Transfer Energy, Not Matter:** The medium itself does not travel with the wave; only energy is transferred . • **Wave Properties: Amplitude:** Maximum displacement from rest position. • **Wavelength (λ):** Distance between two peaks • **Frequency (f):** Number of waves per second (in Hz). • **Period (T):** Time for one wave: T=1/f • **Wave Speed Equation:** v=fλ (Wave speed = frequency × wavelength) • **Reflection, Transmission & Absorption:** Waves can bounce (reflect), pass through (transmit), or be taken in (absorbed) at boundaries. • **Sound Waves (Physics only, HT):** Longitudinal, travel by vibrations; human hearing range is 20 Hz – 20 kHz; solid materials can convert sound into mechanical vibrations. • **Ultrasound and Seismic Waves (Physics only, HT):** • **Ultrasound:** Partially reflected at boundaries → used in medical and industrial imaging. • **Seismic Waves:** P-waves travel through solids & liquids; S-waves only through solids → evidence for Earth's layered structure. • **Electromagnetic Spectrum:** • All are **transverse waves** and travel at **same speed in a vacuum**. • Ordered by increasing frequency: **Radio → Microwave → Infrared → Visible → UV → X-ray → Gamma** • **Wave Behaviours (HT only):** Refraction occurs due to **change in wave speed** between materials. Some waves induce **electrical oscillations** (radio waves). • **Hazards of EM Radiation** • **Lenses (Physics only):** • **Convex lens:** Converges light → can form real or virtual images. • **Concave lens:** Diverges light → only forms virtual images. • **Visible Light and Colour:** • White objects reflect all visible wavelengths; black objects absorb all. • Colour filters absorb some wavelengths and transmit others. • **Black Body Radiation (Physics only):** • **Perfect black body:** Absorbs all radiation; best emitter. • As temperature increases → emits more infrared, and peak wavelength gets shorter.	• **Distinguish between wave types** using diagrams or real-life examples (e.g. ripples vs. sound). • **Use and rearrange equations:** • Calculate wave speed, frequency, wavelength, and period using v=fλv = f\lambdav=fλ and T=1fT = \frac{1}{f}T=f1 • **Interpret wave diagrams:** Identify amplitude, wavelength, and frequency. • **Perform Required Practicals:** • **Ripple tank:** Measure speed, wavelength, and frequency of waves. • **Sound in air:** Use echo method or microphones with oscilloscope. • **Light reflection/refraction:** Use ray boxes, blocks, and mirrors to observe changes in wave direction. • **Infrared radiation:** Compare surfaces to see which absorbs or emits more heat. • **Construct ray diagrams** to show: • **Reflection** (angle of incidence = angle of reflection) • **Refraction** (bending toward or away from normal due to speed change) • **Image formation by lenses** (convex vs. concave) • **Explain phenomena:** • Why ultrasound imaging works • Why S-waves can't go through Earth's core • How EM waves interact with materials (HT only) • **Apply EM spectrum to real-world uses:** Match wave type to its practical application and justify its suitability (e.g. X-rays penetrate body, microwaves heat water molecules). • **Evaluate risks of radiation (HT):** Interpret dose data and weigh health risks (e.g. airport scanners, medical X-rays). • **Explain colour perception:** Based on which wavelengths are absorbed, transmitted or reflected. • **Use black body radiation concepts (HT):** Predict temperature changes in objects (like a car heating up in the sun) and Earth's energy balance.	Year 7 Waves Sound Waves Light Year 8 Energy: Heating and Cooling Waves: Properties and Effects Year 10 P4 Atomic Structure