GRACE COLLEGE Curriculum Outline Year 9 **Science**

Year 9 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 9 Curriculum Overview

Half term 1	Half term 2	Half term 3	Half term 4	Half term 5	Half term 6
Reactions: Chemical Energy Forces: Pressure Genes: Evolution and Inheritance	Mater: Bonding Electromagnetics: Magnets and Electromagnets	Reactions: Rates of Reaction Earth: Solar System	Revision Maths in Science	B1 Cell Biology C1 Atomic Structure and the Periodic Table	C2 Bonding and Structure P1 Energy
Key Question					
Why do chemical reactions transfer energy? What is pressure and what effects can it have? How does our genome change over time and how does it get passed onto our offspring?	How are chemical bonds formed and what type of structures exist? What are the effects of magnetic fields and how does it relate to electricity?	What factors affect the rate of chemical reactions? How does our planet interact with other celestial objects in the solar system?	How do we work Scientifically and use Maths skills in Science	What are the key concepts in Biology? How do structural differences between types of cells enable them to perform specific functions within the organism? What are the key concepts in Chemistry? How can we use the Periodic Table to explain atomic structure and make sense of the chemical and physical properties of elements?	How can we use theories of structure and bonding to explain the physical and chemical properties of Materials? How is energy stored and transferred?
Key Vocabulary					
Catalyst, exothermic, endothermic, chemical bond Pressure, Water, Atmospheric, Sink/Float, Upthrust, Density, Fluids, Area Evolution, Inheritance, Gene, Allele, Chromosomes, Adaptation, Variation	Ionic, Covalent, Metallic, Electrons, Ions Magnets, Magnetism, Electromagnets, Current, Poles, Permanent, Induced	Rate, Reaction, Reactant, Product, Collisions, Temperature, Catalyst, Pressure, Surface Area, Reversible Earth, Moon, Solar System, Satellites, Orbit, Star	Formula, significant figures, percentages, standard form, trends, line of best fit	Eukaryotic, prokaryotic, microscope, specialised cell, Mitosis, diffusion, osmosis, active transport Atom, element, compound, mixture, proton, neutron, electron, isotope, relative atomic mass, group, period, reactivity	Ionic, covalent, metallic, electrostatic force, intermolecular force, polymer Joules, system, gravitational potential, kinetic, elastic potential, power, efficiency, insulation, renewable, non-renewable

Biology Chemistry Physics

GRACE COLLEGE
CORE KNOWLEDGE

Year 9 – SCIENCE HALF TERM 1

	The knowledge you will need to recall:	How you will apply this knowledge:	This links to:
1	Reactions: Chemical Energy - During a chemical reaction bonds are broken (requiring energy) and new bonds formed (releasing energy). - If the energy released is greater than the energy required, the reaction is exothermic. If the reverse, it is endothermic	• Use experimental observations to distinguish exothermic and endothermic reactions. • Use a diagram of relative energy levels of particles to explain energy changes observed during a change of state. • Predict whether a chemical reaction will be exothermic or endothermic given data on bond strengths. • Use energy data to select a reaction for a chemical hand warmer or cool pack	Year 7: Matter Particle Model Year 8: Reactions: Types of Reaction Year 9: Reactions: Rates of Reaction Year 10: C4 Chemical Changes C5 Energy Changes
2	Forces: Pressure - Pressure acts in a fluid in all directions. It increases with depth due to the increased weight of fluid, and results in an upthrust. - Objects sink or float depending on whether the weight of the object is bigger or smaller than the upthrust. - Different stresses on a solid object can be used to explain observations where objects scratch, sink into or break surfaces - Recall the formula: fluid pressure, or stress on a surface = force (N)/area (m2).	• Use diagrams to explain observations of fluids in terms of unequal pressure. • Explain why objects either sink or float depending upon their weight and the upthrust acting on them. • Explain observations where the effects of forces are different because of differences in the area over which they apply. • Given unfamiliar situations, use the formula to calculate fluid pressure or stress on a surface • Use the idea of pressure changing with depth to explain underwater effects. • Carry out calculations involving pressure, force and area in hydraulics, where the effects of applied forces are increased. • Use the idea of stress to deduce potential damage to one solid object by another • Rearrange the formula: fluid pressure, or stress on a surface = force (N)/area (m2).	Year 10: P5 Forces
3	Genes: Evolution and Inheritance - Inherited characteristics are the result of genetic information, in the form of sections of DNA called genes, being transferred from parents to offspring during reproduction. - Chromosomes are long pieces of DNA which contain many genes. - Gametes, carrying half the total number of chromosomes of each parent, combine during fertilisation. - The DNA of every individual is different, except for identical twins. - There is more than one version of each gene eg different blood groups - Natural selection is a theory that explains how species evolve and why extinction occurs. - Biodiversity is vital to maintaining populations. Within a species variation helps against environment changes, avoiding extinction. - Within an ecosystem, having many different species ensures resources are available for other populations, like humans	• Use a diagram to show the relationship between DNA, chromosomes and genes. • Use a diagram to show how genes are inherited. • Explain how a change in the DNA (mutation) may affect an organism and its future offspring. • Explain why offspring from the same parents look similar but are not usually identical • Suggest arguments for and against genetic modification. • Suggest benefits from scientists knowing all the genes in the human genome. • Determine how the number of chromosomes changes during cell division, production of sex cells and fertilisation. • Find out why scientists Watson, Crick and Franklin were so important • Use evidence to explain why a species has become extinct or adapted to changing conditions. • Evaluate whether evidence for a species changing over time supports natural selection. • Explain how a lack of biodiversity can affect an ecosystem. • Describe how preserving biodiversity can provide useful products and services for humans • Predict and explain the changes in a population over time due to natural selection. • Suggest an explanation, based on data, for how a particular evolutionary change occurred. • Evaluate ways of preserving plant or animal material for future generations	Year 7: Ecosystems: Human Reproduction Genes: Variation and Classification Year 10: B7 Ecology Year 11: B6 Inheritance, variation and evolution

GRACE COLLEGE
CORE KNOWLEDGE

Year 9 – SCIENCE HALF TERM 2

	The knowledge you will need to recall:	How you will apply this knowledge:	**This links to:**
1	Mater: Bonding • Atoms bond to get a full outer shell of electrons. • Ionic bonding happens between a metal and a non-metal. • Electrons are transferred in ionic bonding – metal loses, non-metal gains. • Ions are charged atoms: • Positive (metal loses electrons) • Negative (non-metal gains electrons) • Ionic compounds have strong bonds and high melting/boiling points. • Covalent bonding happens between non-metals. • In covalent bonds, atoms share electrons. • Molecules are made of atoms joined by covalent bonds (e.g. H_2O, CO_2). • Simple covalent substances have low melting/boiling points due to weak forces between molecules. • Metallic bonding happens between metal atoms. • Metals have delocalised electrons, allowing them to conduct electricity. • Metal layers slide, making metals malleable (easy to shape).	•Explain why atoms form bonds by describing their need for a full outer electron shell. •Identify ionic or covalent bonding by looking at the types of elements involved (metal + non-metal = ionic; non-metal + non-metal = covalent). •Describe how electrons move in ionic bonding, e.g. "the metal loses electrons and the non-metal gains them." •Draw or label diagrams showing electron transfer in ionic bonding or electron sharing in covalent bonding. •Use the properties of ionic compounds (e.g. high melting point, conducts electricity when molten) to explain observations in practical questions. •Explain why simple covalent molecules (like water or carbon dioxide) have low melting points due to weak forces between molecules. •Use knowledge of metallic bonding to explain why metals conduct electricity or can be bent and shaped. •Predict the type of bonding in unfamiliar substances by using the position of elements in the periodic table. •Compare bonding types to explain differences in properties, like melting points or conductivity. •Describe the structure of giant covalent substances (e.g. diamond or graphite) and relate it to their properties.	Year 9: C1 Atomic Structure C2 Bonding
2	Electromagnetics: Magnets and Electromagnets - An electromagnet uses the principle that a current through a wire causes a magnetic field. - Its strength depends on the current, the core and the number of coils in the solenoid. - The magnetic field of an electromagnet decreases in strength with distance. - Magnetic elements are iron, nickel and cobalt - Magnetic materials, electromagnets and the Earth create magnetic fields which can be described by drawing field lines to show the strength and direction. - The stronger the magnet, and the smaller the distance from it, the greater the force a magnetic object in the field experiences. - Two 'like' magnetic poles repel and two 'unlike' magnetic poles attract. Field lines flow from the north-seeking pole to the south-seeking pole.	• Use a diagram to explain how an electromagnet can be made and how to change its strength. • Explain the choice of electromagnets or permanent magnets for a device in terms of their properties • Critique the design of a device using an electromagnet and suggest improvements. • Suggest how bells, circuit breakers and loudspeakers work, from diagrams • Use the idea of field lines to show how the direction or strength of the field around a magnet varies. Explain observations about navigation using Earth's magnetic field • Predict the pattern of field lines and the force around two magnets placed near each other. Predict how an object made of a magnetic material will behave if placed in or rolled through a magnetic field.	Year 8: Electromagentics: Electricity in the Home Year 9: Voltage, Resistance and Current Electromagnets Year 11: P7 Magnetism and electromagnetism

GRACE COLLEGE
CORE KNOWLEDGE

Year 9 – SCIENCE HALF TERM 3

	The knowledge you will need to recall:	How you will apply this knowledge:	This links to:
1	Reactions: Rates of Reaction • A chemical reaction is when substances change to form new products. • The rate of reaction means how fast a reaction happens. • You can measure the rate by how quickly gas is produced, how fast a solid disappears, or how quickly a colour change happens. • Factors that affect the rate of reaction include: Temperature, Concentration, Surface area and Catalysts • Increasing temperature gives particles more energy, making collisions happen more often and with more force. • Higher concentration means more particles in the same space, leading to more collisions. • Larger surface area (e.g. powdered solid) means more space for collisions to happen. • Catalysts speed up reactions but are not used up in the reaction. • Reactions happen when particles collide with enough energy – this is called the collision theory. • Faster reactions happen when there are more successful collisions per second.	•Explain what "rate of reaction" means using evidence from an experiment (e.g. how fast a gas is made). •Predict how changing a factor (temperature, concentration, etc.) would affect the rate and explain why. •Use collision theory to describe why reactions speed up when temperature or concentration increases. •Interpret graphs or tables showing how quickly a reaction takes place. •Describe how to measure the rate of reaction in a given experiment. •Suggest ways to speed up or slow down a reaction based on what you know about the factors. •Explain the role of a catalyst in increasing the reaction rate without being used up. •Use particle diagrams or descriptions to show how surface area affects collisions. •Compare two reactions and explain why one is faster or slower using scientific reasoning. •Apply your knowledge to a real-world example (e.g. cooking, rusting, fizzing tablets).	Year 7 : Matter Particle Model Reactions: Acids and Alkalis Year 8: Reactions: Types of Reaction Year 9: Reactions: Chemical Energy Year 10: C4 Chemical Changes C5 Energy Changes
2	Earth: Solar System • The Solar System includes the Sun, eight planets, moons, dwarf planets, asteroids, and comets. • The Sun is a star at the centre of the Solar System. • The planets orbit the Sun in nearly circular paths due to gravity. • The inner planets (Mercury, Venus, Earth, Mars) are small and rocky. • The outer planets (Jupiter, Saturn, Uranus, Neptune) are large and made mostly of gas. • A day is one full spin (rotation) of a planet on its axis. • A year is one full orbit (revolution) of a planet around the Sun. • Moons orbit planets. Earth has one moon; other planets have many. • Gravity is the force that keeps planets in orbit and gives weight to objects. • The Moon orbits Earth and causes changes like phases and tides. • The Sun, Earth, and Moon system causes day and night, phases of the Moon, and eclipses.	•Describe the structure of the Solar System and name key objects within it. •Explain the difference between a planet, moon, and star using correct definitions. •Use gravity to explain why planets orbit the Sun and why moons orbit planets. •Compare the inner and outer planets by size, composition, and distance from the Sun. •Use models or diagrams to explain how the Earth's rotation causes day and night. •Explain how the tilt of the Earth's axis and orbit around the Sun cause seasons. •Describe how long a day and a year are and what causes each. •Use diagrams to explain the **phases of the Moon** or how a **solar/lunar eclipse** happens. •Predict what would happen if gravity were weaker or stronger in the Solar System. •Interpret data about planets (e.g. length of day, distance from Sun) to answer comparison questions.	Year 7: Waves: Sound Waves: Light Year 8: Forces: Gravity Year 10 P6 Waves

Year 9 – SCIENCE HALF TERM 4

	The knowledge you will need to recall:	How you will apply this knowledge:	**This links to:**
1	**Maths in Science** • Know how to set out working for calculations in Science. • Identify the number of significant figures. • Use a percentage to calculate a value • Give numbers in standard form • Extract information from tables and graphs. • Plot points on a line graph. • Draw a line of best fit.	• Calculate values with substitution and simple rearrangements of an equation. • Give an answer in the correct number of significant figures • Calculate percentage or percentage change • Calculate unit conversions using prefixes • Describe simple relationships in data • Plot graphs where one or more axes are not given	Using Maths skills in GCSE Science

GRACE COLLEGE CORE KNOWLEDGE

Year 9 – SCIENCE HALF TERM 5

	The knowledge you will need to recall:	How you will apply this knowledge:	This links to:
1	**B1 Cell Biology** • The structure of eukaryotic and prokaryotic cells including plant, animal and bacterial cells. • Cells may be specialised to carry out a particular function including: sperm cells, nerve cells and muscle cells in animals; root hair cells, xylem and phloem cells in plants. • Explain the process and importance of cell differentiation in plants and animals. • Understand the key differences in light and electron microscopy including the concepts of magnification and resolution, • The mathematical relationship between magnification, image size and actual size. • TRIPLE SCIENCE: Understand the technique for culturing microorganisms. • Recall the structures inside the nucleus. • Describe the process of mitosis and explain it's importance. • Understand the nature of stem cells and their application in medicine and plant cloning. • Explain the process of diffusion, factors that can effect the rate and how exchange surfaces are adapted for maximum rate. • Define osmosis and active transport and understand practical applications of these processes.	• Explain how sub-cellular structures are related to their function. • Explain how the structure of different types of cell relate to their function in a tissue, an organ or organ system, or the whole organism. • Understand how microscopy techniques have developed over time • Use a light microscope to observe, draw and label a selection of plant and animal cells. A magnification scale must be included. • Carry out calculations involving magnification, real size and image size using the formula: magnification = size of image/size of real object. • TRIPLE: describe how to prepare an uncontaminated culture using aseptic technique. • TRIPLE: Investigate the effect of antiseptics or antibiotics on bacterial growth using agar plates and measuring zones of inhibition. • Describe situations in given contexts where mitosis is occurring during the cell cycle. • Describe the function of stem cells in embryos, in adult animals and in the meristems in plants. • Explain how different factors affect the rate of diffusion. • Calculate and compare surface area to volume ratios and explain the need for exchange surfaces and a transport system in multicellular organisms • Explain how the small intestine and lungs in mammals, gills in fish, and the roots and leaves in plants, are adapted for exchanging materials • Investigate the effect of a range of concentrations of salt/sugar solutions on the mass of tissue. • Use simple compound measures of rate of water uptake, use percentages, calculate percentage gain and loss of mass of plant tissue and plot, draw and interpret appropriate graphs. • Describe how substances are transported into and out of cells by diffusion, osmosis and active transport and explain the differences between the three processes.	Year 10: B2 Organisation of cells,; exchange in the digestive system and respiratory system; plant exchange and transport. B4: Bioenergetics-photosynthesis and respiration. B5 Homeostasis and responseEndocrine and nervous system; inheritance and reproduction.
2	C1 Atomic Structure and the Periodic Table •All substances are made of **atoms**, the smallest part of an element. •Elements have **symbols** (e.g., O for oxygen, Na for sodium). •**Compounds** form when elements chemically combine in fixed ratios. •Chemical reactions create **new substances** and involve energy changes. •Mixtures are separated by by **physical methods**. •Atomic model developed from solid sphere → plum pudding → nuclear model → Bohr model. •Atoms have **protons (+), neutrons (0), electrons (-)** •Atoms have no overall charge because electrons = protons. •**Isotopes** are atoms of the same element with different neutrons. •Electrons orbit in **shells**; elements in the same group have the same number of outer shell electrons. •The periodic table arranges elements by atomic number and groups with similar properties. •Group 0: noble gases, unreactive with full outer shells. •Group 1: alkali metals, one outer electron, more reactive down the group. •Group 7: halogens, seven outer electrons, less reactive down the group. •TRIPLE: Transition metals have higher melting points, densities, and form coloured compounds.	•Explain what an atom is and identify elements from their chemical symbols. •Describe how compounds are formed from elements and write simple chemical formulas. •Use word and symbol equations to represent chemical reactions. •Interpret diagrams or descriptions of atomic structure, including protons, neutrons, and electrons. •Calculate numbers of protons, neutrons, and electrons in atoms and isotopes given atomic and mass numbers. •Predict the reactivity of elements based on their group in the periodic table (e.g., alkali metals or halogens). •Explain why elements in the same group have similar chemical properties due to their outer electrons. •Compare properties of metals, non-metals, and transition metals using their position in the periodic table. •Use knowledge of isotopes to explain differences in atomic mass and relative atomic mass calculations. •Describe trends in reactivity or physical properties within groups (e.g., increasing reactivity down Group 1).	Year 7: Matter Particle Model Matter: Separating Mixtures Year 8: Matter: Elements Matter: Periodic Table Year 9: Matter Bonding Year 9: C2 Bonding Year 10: C3: Quantitative C4: Chemical Changes C5: Energy Changes C6: Rates Year 11: C8 Chemical Analysis

GRACE COLLEGE
CORE KNOWLEDGE

Year 9 – SCIENCE HALF TERM 6

	The knowledge you will need to recall:	How you will apply this knowledge:	**This links to:**
1	C2 Bonding and Structure • **Three main types of strong chemical bonds:** • **Ionic bonds:** Metal atoms lose electrons, non-metals gain electrons, forming charged ions held by electrostatic forces. • **Covalent bonds:** Atoms share pairs of electrons to form molecules or giant structures. • **Metallic bonds:** Metal atoms share delocalised (free-moving) electrons in a giant structure. • **Ionic compounds** have giant lattices of ions, very strong bonds, high melting/boiling points, and conduct electricity when molten or dissolved. • **Covalent compounds** can be: **Small molecules:** Weak forces between molecules, low melting/boiling points, do not conduct electricity. **Polymers:** Large molecules with strong covalent bonds and stronger intermolecular forces, solid at room temperature. **Giant covalent structures:** All atoms linked by strong bonds (diamond, graphite, silicon dioxide), very hard with high melting points. • **Metals** have giant structures with delocalised electrons allowing: • High melting points, Electrical and thermal conductivity and Malleability (can be bent), but alloys are harder due to distorted layers. • **Carbon structures:** • **Diamond:** Each carbon bonded to 4 others, very hard, no conductivity. • **Graphite:** Layers with 3 bonds per carbon, layers slide, conducts electricity because of delocalised electrons. • **Graphene & Fullerenes:** Special carbon forms useful in technology due to unique structures. • **Nanoparticles:** Tiny particles with very high surface area to volume ratios, have special properties useful in medicine, electronics, cosmetics, etc.	•Explain the differences between ionic, covalent, and metallic bonding using diagrams or descriptions. •Draw dot and cross diagrams to show electron transfer in ionic bonds and electron sharing in covalent bonds for given elements or compounds. •Predict the charge on ions formed by metals in Groups 1 and 2 and non-metals in Groups 6 and 7 based on their position in the periodic table. •Describe the structure of ionic compounds and explain why they have high melting and boiling points. •Compare the properties of small covalent molecules, polymers, and giant covalent structures by linking them to their bonding and structure. •Explain why metals conduct electricity and heat, and describe how the arrangement of atoms changes when metals form alloys. •Describe the differences in structure and properties between diamond and graphite, linking to their bonding. •Identify and explain the uses of graphene, fullerenes, and carbon nanotubes based on their structure and properties. •Explain how nanoparticles differ from bulk materials and evaluate the advantages and risks of using nanoparticles in various applications. •Use particle theory to explain changes of state and how bonding and structure affect melting and boiling points.	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: C3: Quantitative C4: Chemical Changes C5: Energy Changes C6: Rates Year 11: C8 Chemical Analysis
2	P1 Energy • Modern challenges include limits on fossil fuels and global warming to reduce energy usage. • A system is an object or group of objects where energy can be stored in different forms and change during interactions. • Energy changes occur in common situations like moving objects, stretched springs, heating substances, and electrical work. • Key energy calculations include: • Recall the equations: Kinetic Energy ($KE=1/2mv^2$) and Gravitational Potential Energy ($GPE=mgh$), Power ($P=E/t$) and Efficiency (efficiency = useful energy output / total energy input) x100 • Power measures the rate of energy transfer per second • Energy cannot be created or destroyed; it can be transferred usefully, stored, or dissipated as less useful energy (wasted). • Efficiency shows how well energy is used, calculated as useful output divided by total input. • Energy resources include fossil fuels, nuclear, bio-fuel, and renewables like wind, solar, and hydro; renewables can be replenished. • The environmental impact and reliability of energy resources vary, with scientific understanding sometimes limited by political and social factors.	•Describe energy changes and how energy is stored in common systems. •Calculate kinetic energy, elastic potential energy, gravitational potential energy, and changes in thermal energy using given formulae. •Apply equations for power and efficiency. •Investigate energy transfer from gravitational potential to kinetic energy practically. •Investigate specific heat capacity of materials experimentally. •Investigate thermal conductivity and insulation effectiveness practically. •Describe and explain energy conservation, dissipation, and ways to reduce energy loss. •Calculate efficiency and interpret results as decimal or percentage. •Discuss environmental impact of energy resource use and consider scientific vs. societal challenges.	Year 7: Energy: Energy Costs Energy: Energy Transfers and Work Energy: Waves Light/Sound Year 8 Energy: Heating and Cooling Forces: Gravity Year 9: Maths in Science Year 10: P3 Particle Model of Matter P4 Atomic Structure P5 Forces P6 Waves C6 Rates of Reaction