KOINONIA FEDERATION – ALL THROUGH SUBJECT MAP

SUBJECT: Science

CURRICULUM INTENT:

At St Mary Magdalene we have designed our science curriculum to equip and develop the knowledge and skills our students need to understand the natural world around them. Through the acquisition and exploration of key scientific principles, the curriculum promotes scientific enquiry and curiosity to further our pupils' passion for science and prepare them for society in an ever-expanding scientific and technological world.

Please identify what the key themes / concepts are, that all students at all key stages will study in your subject.

These will obviously get progressively more challenging in terms of content / expectations as the years progress and different language might be used to describe them however, they should still be able to fit under a blanket heading.

Please allocate a colour to each of these themes so that it is clear how they are revisited and built upon throughout the curriculum. Please add or remove as appropriate

Biology	Chemistry	Physics	Theme / concept 4

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	AUTUMN 1	AUTUMN 2	SPRING 1	SPRING 2	SUMMER 1	SUMMER 2
NURSERY – KEY THEMES / CONCEPTS	Understanding the World Children know about similarities and differences in relation to places, objects, materials and living things. They talk about the features of their own immediate environment and how environments might vary from one another. They make observations of animals and plants and explain why some things occur and talk about changes.					
NURSERY – KEY CONTENT / LEARNING						
RECEPTION - KEY THEMES / CONCEPTS	Understanding the World Children know about similarities and differences in relation to places, objects, materials and living things. They talk about the features of their own immediate environment and how environments might vary from one another. They make observations of animals and plants and explain why some things occur and talk about changes.					
RECEPTION - KEY CONTENT/ LEARNING						
YEAR 1 - KEY THEMES / CONCEPTS	**Seasonal Changes**	**Plants**	**Animals including Humans**		**Everyday materials**	
YEAR 1 - KEY CONTENT/ LEARNING	• Observe and describe weather associated with the seasons and how day length varies. • Observe changes across	• Identify and name a variety of common wild and garden plants, including deciduous and	• Identify and name a variety of common animals including fish, amphibians, reptiles, birds	• Identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals.	• Distinguish between an object and the material from which it is made. • • Identify and name a variety of everyday	• Distinguish between an object and the material from which it is made. • • Identify and name a variety of everyday

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	the four seasons.	evergreen trees. • Identify and describe the basic structure of a variety of common flowering plants, including trees.	and mammals. • Identify and name a variety of common animals that are carnivores, herbivores and omnivores. • Describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets). • Identify, name, draw and label the basic parts of the human body and say	• Identify and name a variety of common animals that are carnivores, herbivores and omnivores. • Describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets). • Identify, name, draw and label the basic parts of the human body and say which part of the body is	materials, including wood, plastic, glass, metal, water, and rock. • • Describe the simple physical properties of a variety of everyday materials. • Compare and group together a variety of everyday materials on the basis of their simple physical properties.	materials, including wood, plastic, glass, metal, water, and rock. • • Describe the simple physical properties of a variety of everyday materials. • Compare and group together a variety of everyday materials on the basis of their simple physical properties.

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			which part of the body is associated with each sense.	associated with each sense.		
YEAR 2 - KEY THEMES / CONCEPTS	**Everyday Materials**	**Plants**	**Animals including Humans**		**Living Things and Habitats.**	
YEAR 2 - KEY CONTENT/ LEARNING	• Identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. • Find out how the shapes of solid objects made from some materials can be changed by squashing, bending,	• Observe and describe how seeds and bulbs grow into mature plants. • Find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.	• Notice that animals, including humans, have offspring which grow into adults. • Find out about and describe the basic needs of animals, including humans, for survival (water, food and air). • Describe the importance	• Notice that animals, including humans, have offspring which grow into adults. • Find out about and describe the basic needs of animals, including humans, for survival (water, food and air). • Describe the importance for humans of	• Explore and compare the differences between things that are living, dead, and things that have never been alive. • Identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how	• Explore and compare the differences between things that are living, dead, and things that have never been alive. • Identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how

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	twisting and stretching.		for humans of exercise, eating the right amounts of different types of food, and hygiene.	exercise, eating the right amounts of different types of food, and hygiene.	• they depend on each other. • Identify and name a variety of plants and animals in their habitats, including microhabitats. • Describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food.	they depend on each other. • Identify and name a variety of plants and animals in their habitats, including microhabitats. • Describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food.
YEAR 3 - KEY THEMES / CONCEPTS	**Animals including Humans**	**Rocks**	**Plants**	**Light**	**Forces and Magnets**	
YEAR 3 - KEY CONTENT/ LEARNING	• Identify that animals, including humans, need the right types and amount of	• Compare and group together different kinds of rocks on the	• Identify and describe the functions of different parts of flowering	• Recognise that they need light in order to see things and that dark is	• Compare how things move on different surfaces. • Notice that some forces need contact	• Compare how things move on different surfaces. • Notice that some forces need contact

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	nutrition, and that they cannot make their own food; they get nutrition from what they eat. • Identify that humans and some other animals have skeletons and muscles for support, protection and movement.	basis of their appearance and simple physical properties. • Describe in simple terms how fossils are formed when things that have lived are trapped within rock. • Recognise that soils are made from rocks and organic matter.	plants: roots, stem/trunk, leaves and flowers. • Explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant. • Investigate the way in which water is transported within plants. • Explore the part that flowers play in the life cycle of flowering	the absence of light. • Notice that light is reflected from surfaces. • Recognise that light from the sun can be dangerous and that there are ways to protect their eyes. • Recognise that shadows are formed when the light from a light source is blocked by an opaque object. • Find patterns in the way that the size of shadows change.	between two objects, but magnetic forces can act at a distance. • Observe how magnets attract or repel each other and attract some materials and not others. • Compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials. • Describe magnets as having two poles. • Predict whether two magnets will	between two objects, but magnetic forces can act at a distance. • Observe how magnets attract or repel each other and attract some materials and not others. • Compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials. • Describe magnets as having two poles. • Predict whether two magnets will

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			plants, including pollination, seed formation and seed dispersal.		attract or repel each other, depending on which poles are facing.	attract or repel each other, depending on which poles are facing.
YEAR 4 - KEY THEMES / CONCEPTS	**Animals including Humans**	**States of Matter**	**Sound**	**Living Things**	**Electricity**	
YEAR 4 - KEY CONTENT/ LEARNING	• Describe the simple functions of the basic parts of the digestive system in humans. • Identify the different types of teeth in humans and their simple functions. • Construct and interpret a variety of food chains, identifying producers,	• Compare and group materials together, according to whether they are solids, liquids or gases. • Observe that some materials change state when they are heated or cooled, and measure or research the	• Identify how sounds are made, associating some of them with something vibrating. • Recognise that vibrations from sounds travel through a medium to the ear. • Find patterns between the	• Recognise that living things can be grouped in a variety of ways. • Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment.	• Identify common appliances that run on electricity. • Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.	• Identify common appliances that run on electricity. • Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.

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	predators and prey.	temperature at which this happens • in degrees Celsius (°C). • Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.	pitch of a sound and features of the object that produced it. • Find patterns between the volume of a sound and the strength of the vibrations that produced it. • Recognise that sounds get fainter as the distance from the sound source increases.	• Recognise that environments can change and that this can sometimes pose dangers to living things.	• Identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery. • Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit. • Recognise some common conductors and insulators, and associate	• Identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery. • Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit. • Recognise some common conductors and insulators, and associate

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					metals with being good conductors.	metals with being good conductors.
YEAR 5 - KEY THEMES / CONCEPTS	**All Living Things (Living Things and Habitats and Animals including Humans)**		**Properties and their Materials**	**Forces**	**Earth and Space**	
YEAR 5 - KEY CONTENT/ LEARNING	• Describe the life process of reproduction in some plants and animals. • Describe the life process of reproduction in some plants and animals. • Describe the changes as humans develop to old age.	• Describe the life process of reproduction in some plants and animals. • Describe the life process of reproduction in some plants and animals. • Describe the changes as humans develop to old age.	• Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets. • Know that some materials will dissolve in	• Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object. • Identify the effects of air resistance, water resistance and friction, that act between moving surfaces. • Recognise that some mechanisms, including	• Describe the movement of the Earth, and other planets, relative to the Sun in the solar system. • Describe the movement of the Moon relative to the Earth. • Describe the Sun, Earth and Moon as approximately spherical bodies. • Use the idea of the Earth's rotation to explain day	• Describe the movement of the Earth, and other planets, relative to the Sun in the solar system. • Describe the movement of the Moon relative to the Earth. • Describe the Sun, Earth and Moon as approximately spherical bodies. • Use the idea of the Earth's rotation to explain day

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			liquid to form a solution, and describe how to recover a substance from a solution. • Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating. • Give reasons, based on evidence from comparative and fair tests, for the particular uses of	levers, pulleys and gears, allow a smaller force to have a greater effect.	and night and the apparent movement of the sun across the sky.	and night and the apparent movement of the sun across the sky.

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			everyday materials, including metals, wood and plastic. • Demonstrate that dissolving, mixing and changes of state are reversible changes. • Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the	

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			action of acid on bicarbonate of soda.			
YEAR 6 - KEY THEMES / CONCEPTS	**<u>All Living Things</u>**	**<u>Electricity</u>**	**<u>Animals including Humans</u>**		**<u>Light</u>**	
YEAR 6 - KEY CONTENT/ LEARNING	• Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including microorganisms, plants and animals. • Give reasons for classifying plants and animals based on specific characteristics.	• Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit. • Compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off	• Identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood. • Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function.	• Identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood. • Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function. • Describe the ways in which	• Recognise that light appears to travel in straight lines. • Use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye. • Explain that we see things because light travels from light sources	• Recognise that light appears to travel in straight lines. • Use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye. • Explain that we see things because light travels from light sources

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		position of switches. • Use recognised symbols when representing a simple circuit in a diagram	• Describe the ways in which nutrients and water are transported within animals, including humans	nutrients and water are transported within animals, including humans	to our eyes or from light sources to objects and then to our eyes. • Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.	to our eyes or from light sources to objects and then to our eyes. • Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.
YEAR 7 - KEY THEMES / CONCEPTS	Cells & Reproduction	Diet and Health	Particles, Changes of State & Separation Techniques	Elements, Compounds and Mixtures	Forces	Energy
YEAR 7 - KEY CONTENT/ LEARNING	• Contrast the structure and adaptations of different types of cells • Describe how cells and tissues work	• Identify the different food groups and their function in the body • Describe the stages of digestion	• Explain particle theory and how energy can lead to change of states • Describe how different	• Explain how compounds and mixtures are made • Write and balance word	• Identify different types of forces and how we can measure them • Analyse the effect of forces on speed and weight	• Identify the different energy stores and how they can transfer • Describe how electricity is generated from

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	in tandem to form different organs and organ systems • Describe the process of fertilisation and pregnancy	and explain the roles of enzymes • Evaluate the impact of an unbalanced diet	separation techniques can be applied in different scenarios	and chemical equations • Describe the reactions of metals, metal compounds and Group 0	• Explain the cause of pressure and how this can change in different media	renewable and non-renewable energy resources • Evaluate the impact on the environment of non-renewable energy resources
YEAR 8 - KEY THEMES / CONCEPTS	Plants & Respiration and Gas Exchange	Plants & Respiration and Gas Exchange	Chemical Reactions & Acids and Alkalis & Energetics	Interaction and Interdependencies & Genetics and Evolution	Waves & Space	Electricity & Electromagnetism
YEAR 8 - KEY CONTENT/ LEARNING	• Describe basic plant physiology including the structure of the flower • Describe stages of plant reproduction, seed dispersal mechanisms • Describe structure and function of gas exchange systems in humans and the effects of asthma, exercise and smoking • Describe structure of leaves and adaptations for gas exchange	• Explain how energy flows through food chains and webs & trophic levels • Explain how organisms are adapted to their niche in an ecosystem • Explain how organisms can show variation and how this can lead to evolution	•Describe and predict observations and products of chemical reactions •Writing chemical reactions in word and symbol form •Explain and depict energy changes during chemical reactions	• Describing the composition of the Earth and the Earth's atmosphere • Explaining how the stages of the rock cycle lead to the formation of igneous, sedimentary and metamorphic rock • Describe the Carbon cycle and evaluate human impact upon it.	• Describe the properties of waves and how they behave in different medium • Explain how light behaves during reflection and refraction • Describe the place of Earth in the Solar System and explain phenomena such as eclipses, seasons, day &night and phases of the moon	•Explaining current, potential difference and resistance in electrical circuits, both parallel and series • Describe how electromagnets are induced and their uses

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YEAR 9 - KEY THEMES / CONCEPTS	Cell Function and Structure	Organisation of Living Things	Atomic Structure and The Periodic Table	Bonding, Structure and Properties	Atomic Structure and Radiation	Energy
YEAR 9 - KEY CONTENT/ LEARNING	• Identify the structures and functions of animal, plant and bacterial cells • Explain how specialised cells are adapted to their functions • Apply magnification and scale calculations to cells • Compare mitosis, cell differentiation and cell specialisation • Evaluate the uses and limitations of stem cells • Construct explanations of how cell division contributes to growth and repair.	• Recall the functions of major organs and tissues. • Explain how cells form tissues, organs and organ systems. • Apply knowledge of enzymes to digestion. • Analyse how the heart, blood vessels and lungs are adapted for their functions. • Evaluate factors affecting cardiovascular health. • Construct explanations linking digestion, absorption, circulation and respiration.	• Recall the properties of subatomic particles. • Explain how atomic structure determines an element's position in the periodic table. • Calculate numbers of protons, neutrons and electrons. • Analyse patterns in the properties of elements. • Evaluate how scientific evidence has changed models of atomic structure. • Construct models linking electron arrangement to chemical properties.	• Identify ionic, covalent and metallic bonding. • Explain how bonding and structure determine properties. • Apply dot-and-cross diagrams and formulae to represent substances. • Compare the structures and properties of different materials. • Evaluate material suitability for particular applications. • Construct particle-level models explaining material properties	• Recall atomic structure and the properties of alpha, beta and gamma radiation. • Explain radioactive decay and half-life. • Calculate radioactive quantities using appropriate data. • Analyse decay graphs and radiation data. • Evaluate risks and benefits associated with nuclear radiation. • Construct models explaining radioactive decay and its applications	• Recall definitions and equations for current, potential difference, resistance and power. • Explain behaviour in series and parallel circuits. • Calculate electrical quantities using appropriate equations. • Analyse circuit diagrams and experimental data. • Evaluate component choices for particular circuit requirements. • Design circuits that satisfy specified conditions.

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	Biology Photosynthesis and Respiration Infection and Response Homeostasis	**Chemistry** Quantitative Chemistry Chemical and Energy Changes Rates of Chemical Changes	**Physics** Electricity
YEAR 10 - KEY THEMES / CONCEPTS			
YEAR 10 - KEY CONTENT/ LEARNING	• Recall the equations for photosynthesis and respiration. • Explain how energy is transferred during photosynthesis and respiration. • Apply equations to calculate rates of photosynthesis and respiration. • Analyse data showing how environmental factors affect photosynthesis. • Evaluate experimental evidence concerning limiting factors. • Design investigations into factors affecting photosynthesis. • Identify different types of pathogens and diseases. • Explain how pathogens cause disease and how the body defends itself. • Apply knowledge of immune responses to vaccination. • Analyse evidence relating to pathogens and treatments. • Evaluate the effectiveness and limitations of vaccination and antibiotics. • Develop strategies for controlling the spread of infectious disease.	• Recall equations used in quantitative chemistry. • Explain quantitative relationships between reactants and products. • Calculate reacting masses, concentrations, gas volumes and percentage yields. • Analyse quantitative experimental data. • Evaluate the accuracy and reliability of quantitative results. • Develop methods for determining the amount of a substance. • Recall the reactivity series and reactions involving acids. • Explain oxidation, reduction and electrolysis using electron transfer. • Predict products of displacement reactions and electrolysis. • Analyse experimental observations to identify substances or compare reactivity. • Evaluate methods of metal extraction. • Construct methods for obtaining useful substances through chemical reactions. • Identify exothermic and endothermic reactions.	• Recall definitions and equations for current, potential difference, resistance and power. • Explain behaviour in series and parallel circuits. • Calculate electrical quantities using appropriate equations. • Analyse circuit diagrams and experimental data. • Evaluate component choices for particular circuit requirements. • Design circuits that satisfy specified conditions.

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	• Identify the roles of the nervous system and endocrine system. • Explain how negative feedback maintains stable internal conditions. • Apply knowledge of hormonal control to blood glucose and water balance. • Analyse stimulus-response pathways. • Evaluate treatments for disorders involving homeostatic control. • Construct models explaining how negative feedback maintains homeostasis.	• Explain energy transfers through bond breaking and making. • Calculate energy changes from experimental data. • Analyse reaction profiles and activation energies. • Evaluate fuels and chemical reactions for particular applications. • Design investigations comparing energy changes in reactions • Recall factors affecting reaction rates. • Explain reaction rates using collision theory. • Calculate reaction rates from experimental data. • Analyse graphs showing the effects of concentration, temperature, surface area and catalysts. • Evaluate the effects of changing conditions on reaction rate and equilibrium. • Design investigations into factors affecting reaction rate	
YEAR 11 - KEY THEMES / CONCEPTS	**Biology** Inheritance, Variation and Evolution Ecology	**Chemistry** Organic Chemistry Chemical Analysis Chemistry of Atmosphere Using Resources	**Physics** Waves Magnets and Electromagnets Space Physics (Triple Only)
YEAR 11 - KEY	• Define key genetic terminology.	• Recall structures and properties of key organic compounds.	• Recall characteristics of transverse and longitudinal waves.

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CONTENT/ LEARNING	• Explain how genes and alleles influence inherited characteristics. • Apply genetic diagrams and probability to predict offspring. • Analyse genetic information to determine possible genotypes and phenotypes. • Evaluate evidence for natural selection and evolution. • Construct explanations showing how variation and selection can lead to evolutionary change. • Recall key ecological terminology. • Explain interactions between organisms and their environment. • Apply calculations to ecological data. • Analyse food webs and population data. • Evaluate human impacts on biodiversity and conservation strategies. • Design sustainable approaches to maintaining biodiversity	• Explain how hydrocarbon structure affects properties. • Apply molecular formulae and displayed structures. • Analyse patterns within homologous series. • Evaluate the advantages and disadvantages of fuels and polymers. • Construct reaction pathways showing how useful organic compounds can be produced. • Recall chemical tests for common gases, ions and compounds. • Explain how chemical and instrumental analysis identifies substances. • Apply chemical tests and chromatography to unknown samples. • Analyse chromatograms and experimental observations. • Evaluate the reliability and limitations of analytical techniques. • Develop systematic procedures for identifying unknown substances • Recall the composition of Earth's atmosphere and key pollutants. • Explain how human activities affect atmospheric composition and climate. • Apply calculations to emissions data.	• Explain how waves transfer energy. • Calculate wave speed, frequency and wavelength. • Analyse wave diagrams and experimental data. • Evaluate applications of different regions of the electromagnetic spectrum. • Design investigations demonstrating measurable wave properties • Recall properties of magnets, magnetic fields and electromagnets. • Explain interactions between magnetic fields and current-carrying conductors. • Apply Fleming's left-hand rule and relevant equations. • Analyse factors affecting electromagnetic forces. • Evaluate factors affecting motors, generators and transformers. • Design electromagnetic devices for specified purposes • Recall the key features of the Solar System, including planets, moons, stars and other celestial objects. • Explain how gravity determines the motion of planets, moons and artificial satellites. • Apply equations relating to orbital speed, gravitational force, distance and time.

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		• Analyse evidence concerning climate change and atmospheric pollution. • Evaluate proposed solutions to atmospheric problems. • Develop strategies for reducing pollution and greenhouse-gas emissions. • Recall methods of extracting, processing and recycling materials. • Explain how resources can be conserved. • Apply calculations to resource use and environmental impacts. • Analyse life-cycle information for different materials. • Evaluate the environmental and economic implications of resource use. Design sustainable approaches to resource management.	• Analyse data from astronomical observations to identify patterns in planetary and stellar motion. • Explain how the electromagnetic spectrum is used to observe and investigate objects in space. • Analyse evidence from red-shift observations to explain the expansion of the Universe. • Explain how observations of red shift provide evidence for the Big Bang theory. • Evaluate evidence supporting different models and explanations of the Universe. • Calculate astronomical quantities using appropriate data, including distances, speeds and orbital periods. • Construct explanations linking observations of galaxies, red shift and cosmic microwave background radiation to the development of the Big Bang model.
YEAR 12 - KEY THEMES / CONCEPTS	Biological molecules Cells Organisms exchange substances with their environment Genetic information, variation and relationships between organisms	Development of Practical Skills in Chemistry Foundations in Chemistry Periodic Table and Energy Core Organic Chemistry	Particles and radiation Waves Mechanics and materials
YEAR 12 - KEY	• Explain the structures and functions of biological molecules.	• Apply appropriate practical techniques to safely investigate chemical phenomena and collect reliable data.	• Explain the properties and interactions of fundamental particles and radiation. Apply conservation laws and particle

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CONTENT/ LEARNING	• Apply knowledge of molecular structure to biological processes and experimental data. • Analyse how molecular properties determine biological function. • Explain the structure and function of cells and their components. Apply knowledge of transport, cell division and microscopy to unfamiliar contexts. Analyse how cellular structures and processes enable cells to function effectively • Explain how organisms exchange substances with their environment. Apply principles of diffusion, osmosis and mass transport to biological systems. Analyse how exchange surfaces and transport systems are adapted to maximise efficiency. • Explain how DNA, genes and genomes store and transmit genetic information. Apply genetic principles to inheritance, variation and evolution. Analyse genetic and molecular evidence to establish relationships between organisms.	• Analyse experimental data, uncertainties and errors to evaluate the validity and reliability of conclusions. • Evaluate experimental procedures and propose improvements using evidence from observations and data. • Explain atomic structure, electronic structure, bonding and molecular structure using appropriate chemical models. • Apply quantitative methods to calculate amounts of substance, concentrations, yields and reacting quantities. • Analyse acid–base and redox reactions using equations, oxidation states and electron-transfer principles. • Explain periodic trends and use atomic structure to account for the chemical and physical properties of elements and compounds. • Analyse enthalpy changes, reaction rates and equilibrium using appropriate chemical models and quantitative data. • Evaluate the reactions of Group 2 and the halogens and use qualitative analysis to identify inorganic ions. • Explain the structures, properties and reactions of hydrocarbons, alcohols and	models to unfamiliar interactions and calculations. Analyse experimental evidence to evaluate models of particle physics and nuclear processes. • Explain the properties and behaviour of progressive and stationary waves. Apply wave equations and principles of interference, diffraction and polarisation. Analyse experimental and graphical evidence to evaluate wave behaviour and models • Explain the principles governing motion, forces, energy and material behaviour. Apply mechanics equations and models to solve quantitative problems. Analyse force, momentum and material data to evaluate physical systems and assumptions. • Explain charge, current, potential difference, resistance and electrical circuits. Apply electrical relationships and circuit principles to quantitative and practical problems. Analyse circuit behaviour and experimental data to evaluate electrical models.

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		haloalkanes using bonding and reaction mechanisms. • Apply knowledge of functional groups and organic reactions to predict products and construct synthetic routes. • Analyse organic compounds using infrared spectroscopy and mass spectrometry to determine their structures.	
YEAR 13 - KEY THEMES / CONCEPTS	Energy transfers in and between organisms Organisms respond to changes in their internal and external environments Genetics, evolution and ecosystems The control of gene expression	Physical Chemistry and Transition Elements Organic Chemistry and Analysis	Further mechanics and thermal physics Fields Nuclear physics Astrophysics
YEAR 13 - KEY CONTENT/ LEARNING	• Explain how energy is transferred through photosynthesis and respiration. • Apply biochemical principles to calculate and interpret energy transfers. • Analyse factors affecting photosynthesis, respiration and energy transfer within ecosystems • Explain how organisms detect and respond to internal and external changes. Apply principles of nervous, hormonal and homeostatic control to biological situations. Analyse feedback mechanisms and evaluate their importance in maintaining stability.	• Apply quantitative models to calculate equilibrium constants, pH, buffer behaviour, rates and electrochemical quantities. • Analyse enthalpy, entropy and free-energy changes to predict the feasibility and direction of chemical reactions. • Explain and evaluate the chemistry, reactions and properties of transition elements, including their complexes and redox behaviour. • Explain the reactions and mechanisms of aromatic compounds, carbonyl compounds, carboxylic acids, esters and nitrogen-containing compounds.	Explain circular motion, oscillations, thermal behaviour and the kinetic theory of gases. Apply mathematical models to oscillatory, circular and thermal systems. Analyse experimental data and assumptions to evaluate models of mechanical and thermal systems Explain gravitational, electric and magnetic fields and their interactions with matter. Apply field equations and principles to calculate forces, potentials, energy and motion. Analyse field patterns and data to evaluate how fields influence particles and objects. Explain nuclear structure, radioactive decay and nuclear energy. Apply decay equations, conservation laws and nuclear models to quantitative problems. Analyse nuclear data and evidence to evaluate

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	• Explain how genetic variation, selection and ecological interactions influence populations. Apply evolutionary and ecological principles to unfamiliar data and scenarios. Evaluate evidence for evolutionary change and the factors affecting populations and ecosystems. • Explain how gene expression is controlled and regulated. Apply knowledge of transcription, translation and gene regulation to biological contexts. Analyse how changes in gene expression can affect organisms and contribute to disease and biotechnology.	• Apply organic chemistry principles to design multi-step synthetic routes and predict the products of unfamiliar reactions. • Analyse and interpret chromatographic, mass spectrometric and NMR data to identify and determine the structures of organic compounds.	models of nuclear processes and their applications. Explain the properties, evolution and classification of stars and astronomical objects. Apply physical principles to astronomical observations and quantitative problems. Analyse observational evidence to determine properties and evolution of astronomical systems.