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Prince William School

Science Curriculum Overview

Why Teach Science?

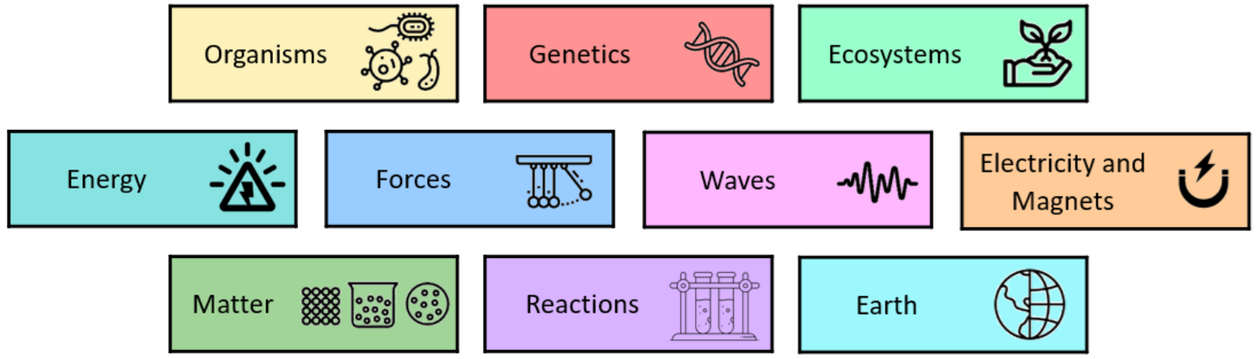
"Science and everyday life cannot and should not be separated" Rosalind Franklin

Our mission is to make Science enjoyable and accessible to all of our students. This will develop curious students who:

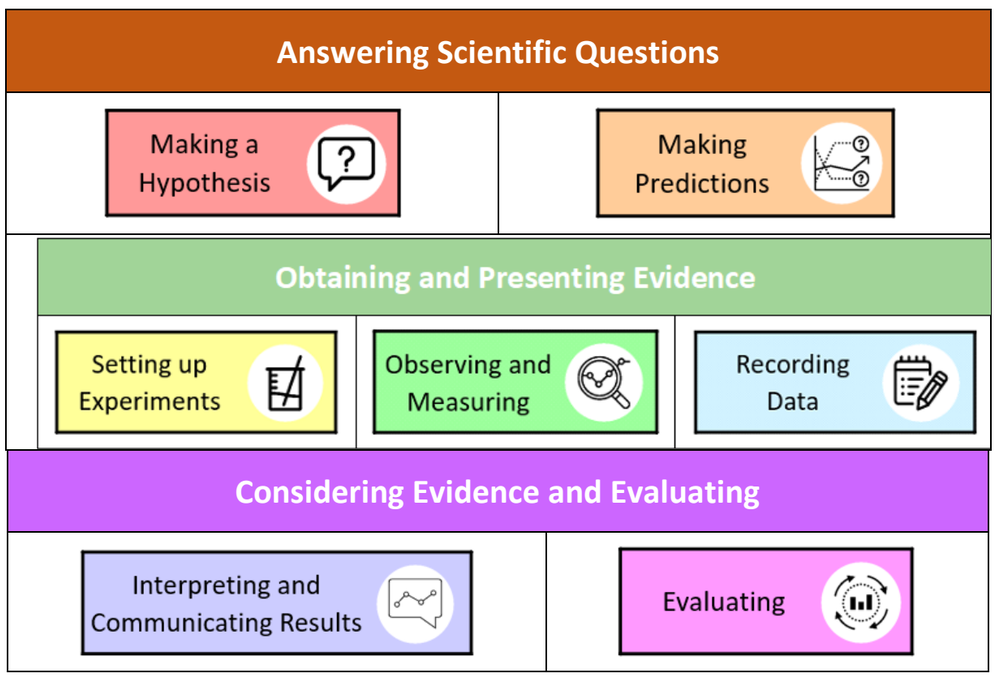
- Have an understanding of the word around them and an appetite to continue to develop that understanding
- Ask important questions about the moral role of Science in society and to question the validity of data in the media
- Have the skills and the knowledge in our students to ensure outcomes in public exams remain high and who are inspired to study Science related subjects at KS5 and beyond

The 10 Big Ideas of the Science Curriculum

Curriculum maps detail the sequencing of substantive knowledge from the disciplines of biology, chemistry and physics to enable pupils to build schemata of important concepts over time through ten 'big ideas'



Disciplinary Knowledge and Enquiry Skills



Learning for Life and Careers

Employability skills

Learning Science develops many high level employability skills such as:

Demonstrating scientific and technical knowledge

Communication skills

The ability to work in a team

Developing a logical thought process and problem-solving skills

Project and time management

Numeracy and the ability to critically analyse data

Using current technology and software to present research and relevant data

Linking the curriculum to careers

Science is absolutely integral to our society and there will always be traditional roles for Scientists in many areas such as conservation, medicine, pharmacy, engineering, developing green technologies, space exploration and many, many more. There are also many problems facing society in the coming years such as combating climate change, loss of biodiversity and managing an increasing human population and there is no doubt that Scientists will play an integral role in managing and solving these problems in the future. However, perhaps the most exciting thing about learning Science is that you are potentially preparing for careers in areas of research that are unknown today. Even in the last decade we have witnessed major Scientific break throughs including:

- Using fluorescent molecules to observe and develop molecules at the nano-scale level
- Observing and studying supermassive black holes
- The ability to edit genetic codes and develop RNA vaccines for diseases such as Covid-19
- Developing "deep learning technology" that can mimic a human brain and develop the use of A.I.
- Advances in genetic testing allowing us to unravel ancient migrations and trace the origins and evolution of humanity

It is exciting to even just imagine what sort of technologies our students could be researching and developing in decades to come.

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Science Curriculum Map – Key Stage 3 Topics by Term

Organisms	Genetics	Ecosystems	Matter	Reactions	Earth	Energy	Forces	Waves	Electricity & Magnets

	Year 7	Year 8	Year 9
Autumn 1	Becoming a Scientist Particle Model Electrical Circuits Matter / Electricity & Magnets	Unicellular Organisms Chemical Reactions Fluids Organisms / Reactions	Cell Structure – B1.1 Atomic Model – P1.1 / C1.1 (inc C1.2) Organisms / Matter
Autumn 2	Forces Elements, Mixtures and Compounds Forces / Matter	Metals Rocks Breathing and Respiration Earth / Organisms	Purity and Separating Mixtures - C2.1 Changes of State – P1.2 Matter
Spring 1	Cells Sound Organisms / Waves	Food and Nutrition Energy Transfers Organisms / Energy	What happens in cells – B.1.2 Respiration - B1.3 Photosynthesis – B1.4 Organisms
Spring 2	Sexual Reproduction Acids and Alkalis Organisms / Reactions	Plants and their reproduction Earth and Space Light Organisms / Waves / Earth	Bonding and Property of Materials – C2.2 / C2.3 Matter
Summer 1	Ecosystems Energy Ecosystems / Energy	Genetics and Evolution Electromagnets Genetics / Earth	Forces – P2.1 / 2.2 / 2.3 Forces
Summer 2	Muscles and Bones Scientific Investigations Organisms / Disciplinary	Motion and Forces Scientific Investigations Forces / Waves	Supplying the Cell – B2.1 Organisms

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Science Curriculum Map – Key Stage 4 Topics by Term

Organisms	Genetics	Ecosystems	Matter	Reactions	Earth	Energy	Forces	Waves	Electricity & Magnets

	Year 10 (Combined Science)			Year 11 (Combined Science)			Year 10 (Triple Science)			Year 11 (Triple Science)		
	Biology	Chemistry	Physics	Biology	Chemistry	Physics	Biology	Chemistry	Physics	Biology	Chemistry	Physics
Autumn 1	The challenges of Size – B2.2	Introducing Chemical Reactions – C3.1	Static and Charge – P3.1 Simple Circuits – P3.2	Natural Selection and Evolution – B5.2	Controlling Reactions – C5.1	Work Done – P5.1	The challenges of Size (B2.2)	Introducing Chemical Reactions (C3.1)	Static and Charge (P3.1)	Natural Selection and Evolution (B5.2)	Controlling Reactions (C5.2)	Radioactive Emissions (P6.1) Uses and Hazards (P6.2)
	Organisms	Matter	Electricity & Magnets	Ecosystems	Reactions	Forces	Organisms	Matter	Electricity & Magnets	Ecosystems	Reactions	Waves
Autumn 2	The Nervous System – B3.1 The Endocrine System – B3.2 Maintaining Internal Environments – B3.3	Energetics – C3.2	Magnets and Magnetic Fields – P3.3	Feeding the Human Race – B6.2	Equilibria – C5.2	Power and Efficiency – P5.2	The Nervous System (B3.1) The Endocrine System- (B3.2)	Energetics (C3.2)	Simple Circuits (P3.2)	Feeding the Human Race (B6.2)	Equilibria (C5.3)	Work Done (P7.1)
	Organisms	Energy	Electricity & Magnets	Ecosystems	Reactions	Forces	Organisms	Energy	Electricity & Magnets	Ecosystems	Reactions	Forces
Spring 1	Ecosystems – B4.1	Types of Chemical Reaction – C3.3	Wave Behaviour – P4.1	Monitoring and Maintaining Health – B6.3	Improving Processes and Products – C6.1	Physics on the Move – P6.1	Maintaining Internal Environments (B3.3)	Types of Chemical Reaction (C3.3) Monitoring Chemical Reactions (C5.1)	Magnets and Magnetic Fields (P4.1) Uses of Magnetism (P4.2)	Monitoring and Maintaining Health (B6.3)	Improving Processes and Products (C6.1)	Power and Efficiency (P7.2)
	Ecosystems	Reactions	Waves	Organisms	Reactions	Forces	Organisms	Reactions	Electricity & Magnets	Organisms	Reactions	Forces
Spring 2	Inheritance – B5.1	Electrolysis – C3.4	The Electromagnetic Spectrum – P4.2	Non-Communicable Diseases – B6.3	Interpreting and Interacting with Earth Systems – C6.2	Powering Earth – P6.2	Ecosystems (B4.1)	Electrolysis (C3.4)	Wave Behaviour (P5.1)	Non-Communicable Diseases (B6.3)	Organic Chemistry (C6.2)	Physics on the Move (P8.1) Powering Earth (P8.2)
	Genetics	Reactions	Waves	Organisms	Earth	Energy	Ecosystems	Reactions	Waves	Organisms	Reactions	Energy
Summer 1	Monitoring and Maintaining the Environment – B6.1	Predicting and Identifying Reactions and Products – C4.1	Radioactive Emissions – P4.3	Revise required practicals	Revise required practicals	Revise required practicals	Inheritance (B5.1)	Predicting Chemical Reactions (C4.1)	The Electromagnetic Spectrum (P5.2)	Practical Skills	Interpreting and Interacting with Earth Systems (C6.3)	Beyond Earth (P8.3)
	Ecosystems	Reactions	Waves	Disciplinary skills	Disciplinary skills	Disciplinary skills	Genetics	Reactions	Waves	Disciplinary	Earth	Earth
Summer 2	Targeted intervention and Practical Skills	Targeted intervention and Practical Skills	Targeted intervention and Practical Skills	Revision & Exams	Revision & Exams	Revision & Exams	Monitoring and Maintaining the Environment (B6.1)	Identifying the Products of Chemical Reactions (C4.2)	Wave Interaction (P5.3)	Revision & Exams	Revision & Exams	Revision & Exams
	Disciplinary skills			Disciplinary skills			Disciplinary skills					

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Science Curriculum Map – Key Stage 5 Topics by Term

Organisms	Genetics	Ecosystems	Matter	Reactions	Earth	Energy	Forces	Waves	Electricity & Magnets

	Year 12			Year 13		
	Biology	Chemistry	Physics	Biology	Chemistry	Physics
Autumn 1	Basic Components of Living Organisms (C2) Exchange surfaces and breathing (C7) Transport in animals (C8) Organisms	Atoms, Ions and Compounds (C2) Amount of Substance (C3) Acids and Redox (C4) Matter	Foundations of Physics (C2) Motion (C3) Forces in Action (C4) Forces	Neuronal Communication (C13) Genetics of Living Systems (C19) Patterns of Inheritance (C20) Organisms / Genetics	Rates of Reactions (C18) Equilibrium (C19) Reactions	Ideal Gases (C15) Circular Motion (C16) Oscillations (C17) Forces / Energy
Autumn 2	Biological Molecules (C3) Transport in Plants (C9) Organisms / Ecosystems	Electrons and Bonding (C5) Shapes of Molecules and Intermolecular Forces (C6) Periodicity (C7) Matter	Work, Energy, and Power (C5) Materials (C6) Forces / Energy	Hormonal Communication (C14) Manipulating Genomes (C21) Organisms / Genetics	Acids, Bases and pH (C20) Buffers and Neutralisation (C21) Enthalpy and Entropy (C22) Reactions / Energy	Gravitational Fields (C18) Stars (C19) Cosmology (C20) Earth / Forces
Spring 1	Enzymes (C4) Plasma Membranes (C5) Classification and Evolution (C10) Organisms / Ecosystems	Basic Concepts of Organic Chemistry (C11) Alkanes (C12) Alkenes (C13) Earth / Reactions	Laws of Motion and Momentum (C7) Charge and Current (C8) Forces	Homeostasis (C15) Cloning and Biotechnology (C22) Organisms	Redox and Electrode Potentials (C23) Transition Metals (C24) Reactions	Capacitance (C21) Electric Fields (C22) Magnetic Fields (C23) Electricity and Magnets
Spring 2	Cell Division (C6) Communicable Diseases (C12) Organisms	Alcohols (C14) Haloalkanes (C15) Spectroscopy (C17) Reactions	Energy, Power, and Resistance (C9) Electrical Circuits (C10) Electricity and Magnets	Respiration (C18) Ecosystems (C23) Organisms / Ecosystems	Aromatic Chemistry (C25) Carbonyls and Carboxylic Acids (C26) Amines, Amino Acids and Proteins (C27) Reactions	Particle Physics (C24) Radioactivity (C25) Matter / Waves
Summer 1	Biodiversity (C11) PAG catchup/refine Ecosystems	Reactivity Trends (C8) Enthalpy (C9) Reactions / Energy	Waves 1 (C11) Waves 2 (C12) Waves	Energy for Biological Processes (C17) Plant responses (C16) Populations and Sustainability (C24) Organisms	Organic Synthesis (C28) Chromatography and Spectroscopy (C29) Reactions	Nuclear Physics (C26) Medical Imaging (C27) Waves / Energy
Summer 2	Neuronal Communication (C13) Organisms	Reaction Rates and Equilibrium (C10) Organic Synthesis (C16) Reactions	Quantum Physics (C13) Thermal Energy (C14) Waves / Energy	Revision & Exams	Revision & Exams	Revision & Exams

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Science Curriculum Map – Substantive Knowledge Progression (KS3/4 Biology)

Organisms	Genetics	Ecosystems	Matter	Reactions	Earth	Energy	Forces	Waves	Electricity & Magnets

Additional content for triple is in red font

		Year 7	Year 8	Year 9	Year 10	Year 11
Organisms	Cells	**Plant and animal cells** • Different cell organelles and their basic functions in plant and animal cells • Plant and animal organs and the cells and tissues they are made from • Basic functions of a light microscope **Sexual reproduction in animals** • The two gametes and how these cells are specialised to facilitate fertilization	**Unicellular Organisms** • Different examples of unicellular organisms particularly focussing on the organelles common to bacteria cells **Respiration** • Respiration occurs in the mitochondria. Identify types of cells likely to contain higher levels of mitochondria **Plants and their Reproduction** • Photosynthesis occurs in the chloroplasts in plant cells. Identify types of cell likely to contain higher levels of chloroplasts • The role of pollen in fertilization in plants.	**Cell Structures** • Prokaryotic and eukaryotic cells. Build on the knowledge of cells organelles and their functions • Evaluate the use of light microscopes and electron microscopes • Calculate the size of a cell from an image using the total magnification of a light microscope **What happens in cells** • Transcription and translation and the role of mRNA and ribosomes **Respiration** • Reinforce respiration occurs in the mitochondria in cells. Discuss why different cells contain different amounts of mitochondria **Photosynthesis** • Structures and roles of different specialised cells during photosynthesis e.g. root hair cells, guard cells, palisade cells **Supplying the cell** • The effect of osmosis on cells • Cell division by Mitosis • What happens when cells differentiate and give examples of differentiated cells including their structure and function • State where stem cells are found in animals and plants **Transport systems** • How red blood cells and plasma are adapted • How the root hair cell is adapted	**The challenges of size** • Differences between red and white blood cells • Structure and function of xylem and phloem • Specialist cells involved in transpiration **The nervous system** • The structure of the nervous system • The structures of the eye • The structure of the brain **The endocrine system** • The cells involved in human reproduction and how they interact throughout the menstrual cycle • How hormones and cells interact during the menstrual cycle **Inheritance** • Meiosis and the difference between gametes and zygotes • The difference between haploid and diploid cells and the number of chromosomes in each • Mutations in DNA can cause variations	**Monitoring and maintaining health** • Describe cancer as the result of changes in cells that lead to uncontrolled growth and division • Explain some of the possible benefits and risks of using gene technology in medicine • Micro-organisms that cause human infections and plant diseases • Plant defences against disease • Role and function of white blood cells in the immune system • The role of monoclonal antibodies • How vaccinations work
	Biological Processes	**Cells** • Cells divide as part of growth and repair **Muscles and bones** • Describe how the thickness of tissues in capillaries facilitates diffusion	**Breathing and respiration** • Distinguish between the purpose of breathing and respiration • State the word equation for respiration Plants and their reproduction Digestion	**What happens in cells** • Describe DNA as a double helix polymer containing nucleotide bases, and **recall a simple description of protein synthesis and link the structure of DNA to the proteins that are produced (HT)** • Explain the mechanism of enzyme action, using examples to analyse how it can be affected by various factors • Digestion of carbohydrates, proteins and fats **Respiration** • Describe cellular respiration as a universal chemical process that occurs continuously to supply ATP in all living cells • Compare and contrast aerobic and anaerobic respiration in eukaryotic organisms • Explain the importance of sugars, amino acids and fatty acids and glycerol in the synthesis and breakdown of carbohydrates, protein and lipids (respectively).	**The nervous system** • Explain how the components of the nervous system produce a coordinated response, including how the structure of a reflex arc is related to its function **The endocrine system** • Describe the principles of hormonal control, **including the roles of thyroxine and adrenaline in a negative feedback loop (HT)** • Explain how plants use hormones for growth, **describing the various effects of auxins, gibberellins, and ethene, and how humans use them (HT)** **Inheritance** • Explain the role of meiotic cell division in halving the chromosome number to form gametes	**Feeding the human race** • Describe genetic engineering as a process which involves modifying the genome of an organism to introduce desirable characteristics • **HT ONLY: Describe the main steps in the process of genetic engineering** **Monitoring and maintaining health** • *BIO ONLY: Describe physical and chemical plant defences* • Explain the role of the immune system of the human body in defence against disease •

			Photosynthesis • Describe experiments to investigate the process of photosynthesis • Explain how different factors can affect the rate of photosynthesis, and **explain the interaction of these factors in limiting the rate of photosynthesis (HT)** **Transport systems (B2)** • Describe the processes of transpiration and translocation in plants		
Biological Systems	**Sexual Reproduction in Animals** • Identify the animal male and female reproductive organs, their structures, and functions. • Describe how sperm cells and egg cells (gametes) are adapted to their functions • Explain how sexual intercourse leads to fertilisation and what happens during pregnancy (gestation). • Describe what puberty is and introduce the idea of the menstrual cycle.	**Sexual reproduction in plants** • Identify the structure of a flower and link their structures to their reproductive functions • Describe what pollination is and the differences between wind and insect pollinated plants in their structures. • Describe and explain how plants can reproduce asexually and sexually. • Explain how asexual reproduction in plants can be manipulated by gardeners, horticulturists and agriculturists.	**Cell Structures** • Introduces the idea of prokaryotes and eukaryotes specifically in organelles used for asexual reproduction. **What happens in cells** • Identify where in the cell transcription and translation occur including the structure of DNA and the role of mRNA and ribosomes **Transport systems (B2)** • Describe the circulatory system, the relationship with the gaseous exchange system and then arrangement of vessels • Explain how the structure of the heart and the blood vessels are adapted to their functions	**Nervous system** • Explain how the structures of the eye are related to their functions, describing common defects of the eye and how some problems are overcome • Describe the function of the brain, explaining some difficulties in investigations and limitations with treating brain damage/disease **The endocrine system** • Name and describe hormones involved in human reproduction and menstruation, **including the interactions between the hormones during the menstrual cycle (HT)** • Explain the use of hormones in contraception and evaluate hormonal and non-hormonal methods, **including those used during IVF (HT)**	**Monitoring and maintaining health** • Describe the non-specific defence systems of the human body against pathogens Explain the role of the immune system of the human body in defence against disease
Movement	Muscles and bones	Forces and motion???	**Scaling up (B2)** • Explain how substances move into and out of cells through diffusion, osmosis, and active transport • Explain the need for exchange surfaces and transport systems in multicellular organisms in terms of surface area to volume ratio • Describe some of the substances transported into and out of a range of organisms in terms of the requirements of those organisms **Transport systems (B2)** • Describe how blood cells are adapted to their transport functions in the blood • Explain how water and mineral ions are taken up by plants, and how environmental factors affect the rate of water uptake • Describe how a simple potometer can be used to investigate the uptake of water in plants	**The nervous system** • Explain how the components of the nervous system produce a coordinated response, including how the structure of a reflex arc is related to its function	•
Genetics — Variation	Variation	Environmental and inherited variation		**Inheritance** • Describe the genome as the entire genetic material of an organism • Recall that all variations arise from mutations in DNA • Describe that the genome, and its interactions with the environment, influence the development of the phenotype of an organisms • **Describe how genetic variants may influence phenotype, including how in coding DNA the activity of a protein can be altered and how in non-coding DNA gene expression can be altered (HT)**	•
Reproduction	**Sexual Reproduction in Animals** • Identify the animal male and female reproductive organs, their structures and functions. • Describe how sperm cells and egg cells (gametes) are adapted to their functions • Explain how sexual intercourse leads to fertilisation and what happens during pregnancy (gestation). • Describe what puberty is and introduce the idea of the menstrual cycle.	**Sexual reproduction in plants** • Identify the structure of a flower and link their structures to their reproductive functions • Describe what pollination is and the differences between wind and insect pollinated plants in their structures. • Describe and explain how plants can reproduce asexually and sexually. • Explain how asexual reproduction in plants can be manipulated by gardeners, horticulturists and agriculturists.	**Cell Structures** • Introduces the idea of prokaryotes and eukaryotes specifically in organelles used for asexual reproduction (mitosis). • describe the process of mitosis in growth, including the cell cycle stages. • recall that stem cells are present in embryonic and adult animals, and meristems in plants and that they can affect division to produce a range of different cell types for development, growth and repair **What happens in cells**	**The endocrine system** • Name and describe hormones involved in human reproduction and menstruation, **including the interactions between the hormones (LH, FSH, progesterone, oestrogen) during the menstrual cycle (HT and BIO)** • Explain the use of hormones in contraception and evaluate hormonal and non-hormonal methods, **including those used during IVF (HT)** • How plant hormones (auxins) effect the growth and therefore the mitotic division in plant cells**.** • ***Bio only: How gibberellins and ethene effect growth and therefore the mitotic division of cells.***	**Inheritance** • Describing the differences between asexual (mitosis) and sexual reproduction (Meiosis) giving examples, • *BIO ONLY: Explain some of the advantages and disadvantages of asexual and sexual reproduction in a range of organisms* • Explain the process of Meiosis introducing the terms haploid and diploid cells. • Explain the role of meiotic cell division in halving the chromosome number to form gametes

			• Identify where in the cell transcription and translation occur including the structure of DNA and the role of mRNA and ribosomes	**Inheritance** • Explain some advantages and disadvantages of sexual and asexual reproduction (HT)	**B6.3.Monitoring and maintaining Health** • Describe the interactions between different types of disease specifically HPV and cervical cancer. • Describe sexually transmitted infections in humans including HIV/AIDS detailing differences between them. • Describe the prevention, symptoms and treatments of STIs.
Evolution	Adaptations	**Genetics and Evolution 9A** • Discuss how adaptations of organisms enable them to survive and link to what may happen if the environment may change quickly • Discuss why certain organisms are endangered and how they have become endangered • Discuss the possibility of extinction and organisms that have become extinct • Introduce the concept of competition, survival of the fittest and natural selection with the work of Charles Darwin • Introduce the theory of evolution • Discuss the evidence for evolution including the fossil record.			• State that there is usually extensive genetic variation within a population of a species • Describe the impact of developments in biology on classification systems • Explain how evolution occurs through the natural selection of variants that have given rise to different phenotypes • Describe evolution as a change in the inherited characteristics of a population over me, through a process of natural selection • Describe the evidence for evolution, to include fossils and antibiotic resistance in bacteria • *BIO ONLY: Describe the work of Darwin and Wallace in the development of the theory of evolution by natural selection* • *BIO ONLY: Explain the impact of the theory of evolution on modern biology and society*
Inheritance	Variation between organisms	**Genetics and Evolution 9A** • Discuss/review the different types of variation – environmental and inherited. • Review the structure of the cell focusing on the nucleus • and its contents • Introduce the structure of DNA and its importance in inheritance • Highlight the importance of DNA discovery and the scientists involved			Explain the following terms: gamete, chromosome, gene, genome, allele/variant, dominant, recessive, homozygous, heterozygous, genotype and phenotype • Describe that the genome, and its interaction with the environment, influence the development of the phenotype of an organism • Recall that all variants arise from mutations, and that most have no effect on the phenotype, some influence phenotype and a very few determine phenotype • ***BIO & HT ONLY: Describe how genetic variants may influence phenotype, to include how in coding DNA the activity of a protein can be altered and how in non-coding DNA gene expression can be altered*** • *BIO ONLY: Explain some of the advantages and disadvantages of asexual and sexual reproduction in a range of organisms* • Explain the role of meiotic cell division in halving the chromosome number to form gametes • Predict the results of single gene crosses and describe sex determination in humans using genetic crosses *BIO ONLY: Describe the development of our understanding of genetics, to include knowledge of Mendel*

Ecosystems	Interdependence	**Ecosystems** Food chains, Food webs and Pyramids of Biomass • Introduce adaptations for different habitats. • Introduce the cause of inherited and environmental variation. • Introduce adaptations to daily and seasonal changes. • Introduce habitats and communities. • Introduce food webs and food chains. • Introduce pyramids of number. • Introduce producer and consumer.	N/A	N/A	**Ecosystems B4** • Introduce the levels of organisation within an ecosystem. • Reinforce producers and consumers. • Introduce abiotic and biotic factors. • Introduce competition and interdependence. • BIO ONLY: Introduce pyramids of biomass. • BIO ONLY: Efficiency of biomass transfer. **Monitoring and Maintaining the Environment B6** • Introduce biodiversity and the effects of human activity. • Intorduce increasing and maintaining biodiversity. • BIO ONLY: introduce monitoring biodiversity and using indicator species.	**Feeding the Human Race B6.2** • BIO ONLY: Introduce food security and factors affecting it. • BIO ONLY: Introduce sustainable food production.
	Cycling	N/A	N/A	**Photosynthesis (B1.3)** • Recall that photosynthetic organisms are the main source of food and therefore biomass for life on Earth	**Ecosystem B4** Decomposition and recycling carbon • Introduce nutrient cycling, including carbon, nitrogen and water. • Introduce a detailed analysis of the carbon cycle. • Introduce decomposers and detritovores. • Introduce the factors that affect the rate of decomposition.	
	Sampling	**Ecosystems** Variations – eye colour Continuous and discontinuous variation • Introduce what a species is. • Introduce continuous and discontinuous variation. •	N/A	N/A	**Monitoring and Maintaining the Environment B6.1** • Introduce sampling techniques. • Introduce the use of identification keys. • Introduce estimating population sizes.	

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Science Curriculum Map – Substantive Knowledge Progression (KS3/4 Chemistry)

Organisms	Genetics	Ecosystems	Matter	Reactions	Earth	Energy	Forces	Waves	Electricity & Magnets

		Year 7	Year 8	Year 9	Year 10	Year 11
Matter	Particle Model	**Particle Model** • Arrangements of particles in a solid, liquid and gas. Recapping the names of the changes of state and describing how the movement of particles changes when a substance changes state • Relating the properties of different substances uto the arrangement and movement of particles • Describe Brownian motion • Explain diffusion in liquids and • Describe what causes gas pressure • **Elements, Mixtures and Compounds** • Introduce the idea of atom and model the differences between elements, compounds • Explain that the properties of compounds can be very different to the properties of the separate elements • Model what happens when a soluble substance dissolves. Explain different separation techniques, particularly filtration and evaporation	**Chemical Reactions** • Using particles diagrams to model the law of conservation of mass including why the mass of solid may increase or decrease through Oxidation or Thermal Decomposition reactions **Fluids** • Recap the arrangement and movement of particles in different states and how this relates to their properties • Describe what happens to particles during changes of state. Relate this understanding to heating and cooling curves • Use particle models to explain why gas pressure changes according to temperature and volume of the container • Relate the forces drag and air resistance to the particle models of a liquid and a gas **Metals and Their Uses** • Use particle models to explain the increase in mass of a metal during Oxidation • Use particle diagrams to explain why pure metals are soft and metal alloys are harder	**The Particle Model and Atomic Structure** • Recap the arrangement of particles in different states of matter and explain the different properties in terms of the arrangement of solids **HT: Introduce the three limitations of the particle model** • Recap the idea of atoms and model the differences between elements, compounds and introduce the term molecule • Introduce the idea that an atom is made up of three sub-atomic particles. Introduce atomic structure and electronic structure including the formation of ions • Describe how the atomic model changed over time including the different models proposed by Dalton, Thompson, Rutherford and Bohr. Explain how this models the Scientific process in terms of the development of ideas over time **Changes of State** • Use particle theory to model changes of state • State that particles gain kinetic energy with increased temperature. Use this to model the relationship between temperature and pressure of a fixed volume of gas. • Define the term density and explain the differences between solids, liquids and gases. Recall and apply the density equation. Describe methods to calculate the density of a regular and an irregular object **Pressure** • **State that particles gain kinetic energy with increased temperature. Use this to model the relationship between gas pressure and volume for a fixed temperature** • **Describe a model of the earth's atmosphere and explain why atmospheric pressure reduces with height above the earth's surface** • **Apply the equation to calculate the pressure in a liquid at different depths. Explain why the pressure in a liquid varies with depth and density** • **Explain how density will effect the upward force on a floating object** **Purity and Separating Mixtures** • Use simple particle models to show how to calculate Relative Formula Mass • Recap the differences in the particle model for a mixture and a compound and use to introduce the terms pure and impure substance • Recap what happens when a soluble substance dissolves and use to explain different separation techniques, particularly filtration and evaporation	**Introducing Chemical Reactions** • Recap the different types of formulae including molecular formula, empirical formula, and displayed models such as the ball and stick model. Give advantages and disadvantages of each formula type • Recap the particles diagrams to reinforce the law of conservation of mass including why the mass of solid may increase or decrease through Oxidation or Thermal Decomposition reactions • Explain the importance of balancing chemical equations in terms of the conservation of mass • **HT: Introduce the term mole and stoichiometry. Use the mole equation to calculate the mass of reactants or products across an equation. Introduce the term limiting reactant.** • **HT: Calculating the empirical formula using moles calculations** **Types of Chemical Reaction** • Modelling the idea of an acid or alkali as a substance that ionises into H^+ or OH^- ions and the difference between a strong acid and a weak acid • Use a simple particle diagram to model the difference between a concentrated acid and a dilute acid **Electrolysis** • Showing the movement of anions and cations to the respective electrodes during simple electrolysis **Monitoring Chemical Reactions** • **Recap the term mole and stoichiometry. Use the mole equation to calculate the mass of reactants or products across an equation. Apply this to titration calculations**	**Controlling Reactions** • Drawing simple particle diagrams to model collision theory. Recap the idea that particles move faster as temperature increases. • Recap the difference between a concentrated acid and a dilute acid and use to explain relative rates of reaction • Recap the difference between low and high pressure in a gas in terms of number of particles and use to explain relative rates of reaction **Improving Processes and Products (Organic Chemistry)** • Recap the idea of displayed formula and use to differentiate between alkanes and alkenes • **Introduce the displayed formula of alcohols, carboxylic acids and esters.** • **Modelling the formation of addition polymers from alkenes as a balanced equation** • **Modelling the formation of condensation polymers using different functional groups as balanced equations**

Periodic Table

		Bonding and Properties of Materials • Introduce Ionic Bonding diagrams followed by how the ions become arranged into a giant ionic lattice. Explain how this structure relates to the properties of Ionic compounds (i.e. conductivity and relative melting / boiling points) • Introduce covalent bonding diagrams and categorise substances in terms of either simple molecules or giant covalent structures (including the different allotropes of Carbon). Explain how each structure relates to the properties of covalent compounds (e.g. conductivity, relative hardness and elative melting / boiling points, distinguishing between weak intermolecular forces and different types bonds). • Introduce the diagram for metallic bonding and use to explain typical properties of metals (e.g. conductivity, relative melting and boiling point) Recap the model of a pure metal and a metal alloy to explain relative hardness. • Describe a polymer as a long chain of monomers. Explain that the relative melting point can be increased by crosslinking including useful practical examples • Discuss the model for Buckminster Fullerene and use to define nanoparticles and relate their properties, uses (and risks) to their structure		
Elements, Mixtures and Compounds • Using the periodic table to identify elements by both name and symbol. Link to the definition of element and compound.	**Metals and Their Uses** • Identify metals and non-metals in the periodic table and their differing properties (including how we can test that an element is a metal) • Using the reaction of metals with water identify that the alkali metals are grouped together in group 1 because they react in a similar way	**The Particle Model and Atomic Structure** • Identifying the atomic number and the mass number for each element. Use these to calculate the number of protons, neutrons and electrons in a given atom, ion or isotope • Use the idea of isotopes to introduce the term explain the term relative atomic mass (with reference to Chlorine) • Use mass numbers to calculate relative formula mass **Bonding and Properties of Materials** • Link the group number and period for an element to its electronic structure. Use this to predict the likely ion an atom will form from its group number • Identify differences between the modern periodic table and earlier versions. Explain how Mendeleev's periodic table developed into the modern version • Link the reactivity of group 1 and 0 elements to their position in the periodic table and hence their electronic structure	**Predicting Chemical Reactions** • Recap the relative reactivity of Group 0 elements • Describe the reactivity of group 1 and group 7 elements changes down the group. Use the trends to predict the products of displacement reactions. • **HT: Explain how the reactivity of group 1 and group 7 elements changes down the group.** • **Identify the transition metals in the periodic table and recall the general properties of transition metals**	**Improving Processes and Products** • The role of transition metals as catalysts in reactions such as the Haber process and the contact process
Elements, Mixtures and Compounds • Differentiating between a physical change and a chemical reaction • Suggesting typical observations seen during a chemical reaction • Constructing a word equation **Elements, Mixtures and Compounds** • Introducing common types of reaction e.g. neutralisation or combustion • Forming word equations for reactions between acids and alkalis **Acids and Alkalis** • Introducing the word equation for a neutralisation reaction and how the name of the salt produced relates to the acid used	**Chemical Reactions** • Revising word equations and introducing simple symbol equations for reactions • Introducing the ideas that chemical reactions can be either exothermic or endothermic • Introducing combustion (of fuels) **Metals** • Introducing the reaction between metal and acid. Recap that the name of the salt produces relates to the acid used • Introducing displacement reactions and how these can be predicted using the reactivity series • Introduce the idea of corrosion and methods to reduce particularly rusting **Breathing and Respiration** • Respiration is an example of an exothermic reaction **Food and Nutrition** • Discuss the similarities between respiration and combustion **Plants and their reproduction**	**Respiration** • Reinforce that respiration as an exothermic reaction **Photosynthesis** • Reinforce that photosynthesis as an endothermic reaction **Atomic Structure** • Revise the difference between and chemical reaction and physical change • Introduce the concept of atoms gaining or losing electrons during a chemical reaction in order to achieve a full outer shell of electrons **Bonding** • Develop idea that when Ionic Bonds form, electrons are transferred from one atom to another. •	**Introducing Chemical Reactions** • Show that equations can be modelled using balanced symbol equations. Relate this to the conservation of mass **Energetics** • Give examples of common exothermic and endothermic reactions • Use energy levels diagrams to model the change in energy during an exothermic or endothermic reaction • Use bond enthalpy data to calculate the change in energy during an exothermic or endothermic reaction **Types of Chemical Reaction** • Introduce the idea of an ionic equation and use to model neutralisation reactions • Give the general equations for the reaction of Alkalis, Metals and Carbonates with common lab acid • Introduce the terms Oxidation, Reduction and Redox	**Monitoring Chemical Reactions** • Recall the general equation for neutralisation and model in terms of balanced symbol equations • Show how such equations can be used to determine the concentration of an unknown solution through performing a titration **Controlling Reactions** • Introduce the idea of collision theory. Use collision theory to model the effect of temperature, pressure, concentration and surface area on the rate of a reaction • Explain the economic and environmental benefits of using a catalyst **Equilibria** • Define the term reversible reaction and demonstrate how reversible reactions are modelled using the reversible equation. • Define the term equilibrium

			• Photosynthesis is an example of an endothermic reaction		**Electrolysis** Introduce the idea of half equations. Use half equations to model the reactions that occur at the anode and the cathode during electrolysis. • Identify half equations as either Oxidation or Reduction in terms of the transfer of electrons • Introduce the term Redox **Predicting Chemical reactions** • Discuss the common reactions of group 1 metals. • Use the reaction of group 1 metals to demonstrate and explain the differing reactivity of elements as you go down group 1 • Revise the idea of displacement reactions in metals. Introduce the idea of displacement reactions involving the group 7 elements. Use these reactions to explain the differing reactivity of elements as you go down group 7 • Explain why group 0 elements are inert • **Identify the transition metals in the periodic table and describe their use as catalysts in chemical reactions** • State the chemical tests for common gases and the expected observations • **State the common tests for cations and anions and the expected observations.**	• HT: Explain how the position of equilibrium can be changed by changing the temperature and pressure. Explain the effect that a catalyst will have on the equilibrium • **Haber process - Explain the steps used in the manufacture of ammonia for fertilizers including the optimum conditions for the reaction both in terms of rate and yield.** • **Contact process - Explain the steps used in the manufacture of sulfuric acid including the optimum conditions for the reaction both in terms of rate and yield.** • **Using balanced equations model the two different methods used in the industrial preparation of ethanol including the required conditions. Evaluate the two methods** **Improving Processes and Products** • Model the extraction of Iron from Iron Oxide in the blast furnace • Model the extraction of Aluminium from Aluminium Oxide through electrolysis. State the half equation at each electrode •
		•	**Solar system** • Learn the name and order of planets in our solar system • Learn how the movement of planets gives day / night and years • Explain the seasons in terms of the tilt of the earth's axis • Define moons as a natural satellites and the uses of artificial satellites •	•	•	Beyond Earth • Explain evidence for the big bang theory • Revise the make up of our solar system including the life cycle of starts • State examples and uses of satellites in geostationary and low polar orbit. • Explain the relationship between the temperature of an object and the type of radiation emitted and absorbed •
Reactions		**Energy** • Introduce examples of renewable and non-renewable energy resources. Explain how fossil fuels were formed •	•	**Magnets and Magnetic Fields** • Draw a diagram showing the earth's magnetic field • Recognise that the geographic north pole is the south pole of the magnetic field **Radioactive Emissions** • We can extract radioactive isotopes from the earth to use in nuclear fission •	•	**Powering Earth** • Learn examples of non-renewable and renewable energy resources and evaluate their effectiveness • Explain patterns and trends in the use of energy resources over time **Improving Processes and Products** • Define the term metal ore and use to explain why metals are a finite resource • Consider methods of extracting Iron, Aluminium and Copper from their respective ores including the environmental and economic impact. Relate the method of extraction to the relative reactivity of each metal • Explain the terms low grade and high grade ore and using copper as an example explain why new technologies are required to extract low grade metal ores • Greenhouse gases Beyond Earth • How the earth's atmosphere effects global temperatures • How P waves and S waves give evidence for the structure of the earth

Earth	Universe	**Energy** • Define the term energy store giving examples. Explain how energy can be transferred • State the law of conservation of energy • Food is a store of chemical energy which can be released and transferred • Define the term fuel and state that combustion transfers the stored energy • Give examples of renewable and non-renewable energy		**Forces** • Recall the equation to calculate kinetic energy and gravitational potential energy. • Recall the equation to calculate work done **Forces in Action** • Calculate the energy stored in a stretched spring	**Simple Circuits** • Calculate the energy transferred in a simple circuit	**Work Done** • Calculate the energy in different energy stores e.g. Thermal, Kinetic, Gravitational and Elastic Potential • Recall the different ways that energy can be transferred e.g. mechanically, electrically and heating by particle or radiation • Analyse the way energy is transferred including calculations to work out the energy transferred between stores **Power and Efficiency** • Describe what is meant by a unit of electricity • Define a kilowatt hour and use to measure energy use in a home • Calculate the price of using electricity in the home
	Structure and resources of Earth		**Energy transfers** • Describe the difference between temperature and heat. • Explain how heat energy is transferred through conduction convection and radiation • Explain different methods of reducing energy loss in buildings. Calculate the efficiency of different measures and the idea of payback time.	**Changes of state** • Explain the difference between temperature and heat energy including units for each • Explain the changes in state in terms of the increasing energy of the particles and how we model this using heating / cooling curves. • Define the terms specific heat capacity and specific latent heat. Use given equations to calculate unknown values.		**Power and Efficiency** • Analyse the way energy is transferred including calculations to work out the energy transferred between stores when heating • Explain ways of reducing unwanted energy transfer e.g. through insulation / lubrication • Explain why the rate of cooling depends on the thermal conductivity and thickness of a material. Recap the efficiency calculation
Energy	Energy Stores					
	Heating and Cooling	•	•	•	•	

Prince William School

Science Curriculum Map – Substantive Knowledge Progression (KS3/4 Physics)

Organisms	Genetics	Ecosystems	Matter	Reactions	Earth	Energy	Forces	Waves	Electricity & Magnets

		Year 7	Year 8	Year 9	Year 10	Year 11
Forces	Contact Forces	**Different Forces (Contact forces)** • Introduce several types of forces and classify them as contact or non-contact forces. Examples to include; Air resistance, water resistance, upthrust and friction. • To explain that force is measured in Newtons and can be measured using a Force Meter (Newton Meter).	**Drag** To describe the effects of drag on objects moving in air and water. To explain how streamlining can be used to reduce drag. **Floating and sinking** To describe the relationship between upthrust and weight in keeping objects afloat.	**Motion (Distance, time & speed)** How to measure simple distances and times and explain the choice of instruments used to measure distance and time. How to calculate the speed of an object. To state some different units for speed. To calculate speed by converting between every day and scientific units. **Motion (Vectors and scalars)** To state some examples of scalar and vector quantities and explain the difference between a scalar and a vector. To explain why it is difficult to combine vectors. To state that distance and speed are scalars, and that displacement and velocity are their vector equivalents. To explain the difference between distance and displacement, and between speed and velocity. To explain how an object can have zero displacement and non-zero distance, and how it can have constant speed and still accelerate. To label arrows to represent the size and direction of vectors. To use positive and negative signs to show the direction of 1D vectors. To explain how to combine vectors to find the resultant vector. **Motion (Acceleration)** To describe acceleration, state the measurements needed to find acceleration, and identify anomalous measurements. To explain what acceleration is, use the equation for acceleration to calculate acceleration, and identify sources of random and systematic error in an experimental method to measure acceleration. To explain the difference between acceleration and velocity, use the equation for acceleration to calculate acceleration, final velocity, initial velocity, or time. To explain anomalous measurements and suggest improvements to an experimental method to reduce the errors. **Motion (Distance-time graphs)** To describe the motion of objects represented by simple distance-time graphs, state that the gradient of a distance-time graph represents the speed, and measure distances and times to construct a distance-time graph. To interpret distance-time graphs and displacement-time graphs, use a distance-time graph to calculate speed, and plan and collect measurements to draw a distance-time graph. To describe the difference between distance-time and displacement-time graphs and calculate velocity from a displacement-time graph.	**Magnets and magnetic fields** To state that magnets can attract or repel and describe how magnets behave by linking this behaviour to magnetic field lines. To explain the behaviour of a compass in terms of the Earth's magnetic field lines. To state examples of permanent and induced magnetism and describe the difference between permanent and induced magnetism. To explain induced and permanent magnetism using the domain theory. To describe an experiment that allows magnetic field lines to be seen. To draw 2D representations of magnetic field lines for a bar magnet and the Earth. To draw 2D representations of magnetic field lines to explain attraction and repulsion. **Uses of magnetism** To describe evidence for the magnetic field around a wire and describe the factors affecting the strength of the magnetic field around a wire. To explain the factors affecting the strength of the magnetic field around a wire. To draw the pattern of the magnetic field around a wire and describe the direction of the magnetic field around a wire. To explain why increasing the number of loops makes the magnetic field around a solenoid larger than that around a single wire. To describe the force between a magnet and current-carrying conductor and use Fleming's left-hand rule to work out its direction. To explain why there is a force on a current-carrying wire and between attracting magnets. To calculate the force on a current-carrying wire and use the equation for force on a current-carrying wire to find force, current, length of conductor, or field strength. To draw the field lines for a current-carrying wire and between attracting magnets and use a drawing of combined field lines to explain direction of the force.	Energy analysis with forces To state the equation for energy transfer by mechanical working. To calculate the energy store and energy transferred by mechanical working. To use calculations involving energy stores and mechanical working for objects accelerating due to constant force. To follow instructions and use light gates to measure the velocity of a trolley. To apply knowledge and select appropriate apparatus to measure the velocity of the trolley.

					Motors To describe how you can use a current-carrying wire and magnets to make a coil rotate. To describe how a motor works and explain why the coil rotates in terms of magnetic fields. To explain the factors that affect the speed of rotation in terms of magnetic fields and describe uses of motors in everyday life. **Electromagnetic induction** To describe electromagnetic induction and explain how to increase the induced potential difference. To describe the direction of the induced potential difference and explain the direction of the induced potential difference. To use ratios to estimate the induced potential difference when one or more factors are changed. **Generators** To describe how electromagnetic induction is used to produce a.c. and d.c. To compare a.c. and d.c. generators and describe how the output of generators can be increased. To explain how the output of generators can be increased. **Transformers** To explain the construction of a transformer. To calculate potential differences on the primary and secondary coils using ratios. To calculate the numbers of turns on the primary and secondary coils using the transformer equation. To describe the magnetic field around a wire carrying a.c. and explain the forces between coils carrying a.c. current. Microphones and loudspeakers To describe the structure of a microphone and explain how a microphone works. To describe the structure of a loudspeaker and explain how a loudspeaker works. To compare loudspeakers and microphones and explain whether a loudspeaker can be used as a microphone.	
Non-Contact Forces	**Different Forces (Non-Contact forces)** Introduce several types of forces and classify them as contact or non-contact forces. Examples to include; Gravity, static electricity, and magnetism. **Mass & weight** • To explain the difference between mass and weight. **Springs** • Investigating the properties of elastic and plastic materials (Hooke's Law). • Graphing data on force and extension to identify the limit of proportionality and the elastic limit. • To describe the relationship between the force applied and the extension of an elastic material.		**Motion (Velocity-time graphs)** To interpret velocity-time graphs, use a velocity-time graph to calculate acceleration and distance travelled for an object with constant acceleration, and calculate the area under a graph representing constant acceleration. To use a velocity-time graph to calculate acceleration and distance travelled for a non-uniform motion. **Motion (Equations of motion and kinetic energy)** To state the factors that affect kinetic energy and use the equation for kinetic energy to find kinetic energy, mass, or velocity. To state the equation that links initial velocity, final velocity, acceleration, and distance travelled, and under what condition it can be used. To use the kinematics equation and rearrange it to find initial velocity, final velocity, acceleration, or distance travelled.		

		Friction To describe the effects of friction and ways to control friction such as streamlining and lubrication. **Pressure** • To describe the relationship between force, pressure, and area. • To identify and apply the SI units for force, mass, pressure, and area. **SI Units** To identify SI units, their symbols, and names, to include; Length, area, volume, mass, time, force, pressure, energy, and speed. **Prefixes** To learn the symbols, meaning, and examples of the following prefixes: Mega, kilo, deci, centi, milli, micro, nano. **Balanced and unbalanced forces** To describe and identify balanced and unbalanced forces and explain their effects on the motion of an object.		To state and explain whether measurements are repeatable and identify sources of error. **Forces in action (Stretching springs)** To describe how you can deform objects, the difference between plastic and elastic behaviour, and explain the use of elastic and plastic behaviour in modern materials. To describe the relationship between force and extension for a spring, explain the shape of a force–extension graph for a spring and calculate the spring constant, and explain what factors will affect the spring constant. **Forces in action (Stretching materials and storing energy)** To state that different materials have different shapes of force–extension graph, describe the relationship between force and extension for materials such as rubber, copper, and glass. To state the factors that affect the work done when stretching a material, calculate the work done in stretching, calculate the work done in stretching from a force–extension graph. To describe and explain linear and non-linear relationships from force–extension graphs. **Forces in action (Gravitational field and potential energy)** To state the gravitational field strength, g, and state the acceleration due to gravity on Earth, also called g. To explain what is meant by a gravitational field, gravity force, and weight. To explain why gravitational field strength, g, and acceleration due to gravity, g, have the same magnitude. To state the factors affecting gravity force, calculate gravity force and gravitational potential energy, and apply the equations for gravity force and gravitational potential energy and see how they are inter-related. To state that g decreases with increasing distance from a planet and describe how g varies with distance from a planet. To use the inverse square relationship to determine g at a distance. **Turning forces** To describe how forces cause a rotation, calculate moments given perpendicular distance and force, and calculate moments where the perpendicular distance must be identified. To state that clockwise moments equal anticlockwise moments when an object is in equilibrium and apply the principle of moments. To follow instructions and use the principle of moments to find an unknown mass. To design a method to find an unknown mass and compare it with the measured mass. **Simple Machines** To describe uses of levers and gears and explain how they work. To explain how gears can be used to multiply force or distance. To calculate a ratio of two values and use ratios to calculate forces or distances involved. To state the definition of mechanical advantage. and calculate the mechanical advantage of simple machines. To suggest how to improve the mechanical advantage of a range of simple machines. Hydraulics To describe how a fluid causes a force and what factors affect the size of the force. To explain how a fluid causes a force and calculate the force using the pressure equation. To name examples of hydraulic machines, describe how hydraulic machines work, and calculate how much a hydraulic machine multiplies a force.		

Waves	Sound	**Reproduction in Animals** • Use of ultrasound to view image of foetus **Sound** • Understand how to describe sound waves using key words like intensity, volume, pitch and frequency • Recognising the units of frequency are Hertz (Hz) • Sound waves in most animals are made by vibrating flaps called your vocal chords • Noticeable exceptions are insects like grasshoppers that rub their legs together or gorillas that pound their chest to make the vibrations. • Sound waves are detected by the vibrations they create in your ear or a microphone • The audible range of humans and other animals and how they differ • How sound can be used in communication and echo location and sonar		• Using ultrasound to measure the speed of objects to plot distance time graphs	**Magnets** • **Sound can be detected by the virations on the diaphragm of a microphone** • **Sound can be created by vibrating the diaphragm of a speaker** **Waves in matter** • Oscilloscopes can be used to display sound waves • Using microphones in different positions to measure the speed of sound • Ultrasound is sound of frequency higher than the human ear can detect • Maths calculations using sonar examples • It reflects and refracts through mediums so is used to make a baby scan • How the ear works and why we can not hear the same frequencies as other animals	
	Electromagnetic Waves	**Energy** • Light is a means of transferring energy • This energy transfer is necessary in Photosynthesis	**Light** • Light can interact with materials in a number of ways, transmitted through transparent objects, reflected and absorbed through opaque objects and scattered through translucent objects • You can represent how light travels using straight lines with arrow to show direction. • Difference between specular reflection and diffuse reflection • How ray diagrams can help us understand how we can see images in mirrors • Refraction occurs when light moves through different mediums • Lenses help refract light • How the eye works • The primary colours of light • How we perceive objects to be different colours in terms of reflection of certain colours of light	• Using light gates to measure the speed of objects to plot distance time graphs	**Electricity** • Lamps and LED's give off light • LDRs resistance is affected by the intensity of light **Properties** • The order of the electromagnetic spectrum • What are electromagnetic waves? • How can you produce and detect microwaves • How are frequency and wavelength related **Uses and dangers** • How we use a wide range of the EM spectrum to communicate • Other uses like heating food, reading data off CDs and medical uses • The risk of high frequency waves damaging DNA and leading to skin cancer **Imaging** • How we can use a charge-coupled device to detect electromagnetic waves • What are x-rays and CT scans • How is gamma used for imaging **Wave Interactions** • Using ray diagrams, with a correctly drawn normal line to show reflection and refraction • What causes reflection and refraction • What are lenses, how do they arok and how to draw ray diagrams with lenses to accurately describe the images that are produced. • How to use a prism to disperse white light • Why objects appear certain colours and how filters work	**Radioactive emissions** • Gamma is a radiaoactive emission with a high frequency and ability to transmit through most things. • Electromagnetic waves can also be represented by a photon with a certain energy related to the frequency of that wave. • Visible light photons can be absorbed by the electrons in atoms as they change energy levels and then are re-emitted to produce absorption and emission spectrum **Uses and Hazards** • Gamma can be used to discover and kill cancerous cells. **Energy transfers** • EM waves an transfer energy via the heating by radiation pathway • **Physics on the move** • Using EM waves in speed cameras and radar guns to detect the speed of objects • **Beyond the Earth** • Object in our universe that are giving of EM waves are moving away from us their waves are red shifted. They are blue shifted if they are moving towards us • Microwaves are used to communicate with Satalites in orbit as they are able to transmit through our atmosphere rather than being reflected or absorbed. • Hot objects emit EM waves, the hotter they are the higher the frequency of wave that is emitted. • How the earths atmosphere interacts with various EM waves and the impact of CO_2 on global temperatures due to its ability to reflect waves back to the surface. •
	Wave Properties	**Waves** • Waves transfer energy, not matter. • Sound waves are longitudinal waves • Sound requires a medium to travel through so there can be no sound waves in a vacuum • Water waves are transverse waves • How waves that meet can superpose and create interference patterns • As waves move further from their source their intensity decreases	**Waves** • The differences between transvers and longitudinal waves		**Waves in Matter** • Labelling a transverse and longitudinal wave and making comparisons between the oscillations and the energy transfer • Using the equation v=fλ and how to experimentally calculate the velocity of a wave •	• **Beyond the Earth** • If objects emitting waves move relative to an observe the wavelength of the wave is changed. • S are trasverse waves, P waves are longitudinal waves. • The way they move through different mediums has helped us to understand about the structure of our planet.

Electricity and Magnets	Current	**Current Electricity** Measuring current, series and parallel circuits • Introduce current. • Introduce the use of models to demonstrate electric circuits. • Introduce circuit symbols.	**Forces and Electromagnets** • Introduce static electricity. • Reinforce current. •		**Static and Charge** • Introduce charge and static electricity. • Introduce the transfer of electrons between objects. • Reinforce current and how to measure it. **Simple circuits** • Introduce DC circuits. • Reinforce circuit symbols. • Introduce how current flows in a parallel and series circuit.	**Work done** • Introduce electricity as a method of energy transfer. **Power and Efficiency** • Reinforce electrical current transfers energy. • Reinforce the electrical power equation. •
	Voltage and Resistance	**Current Electricity** Measuring voltage, series and parallel circuits • Introduce voltage. • Introduce how number of bulbs affect the current. • Introduce series and parallel circuits.	**Forces and Electromagnets** • Introduce resistance.	N/A	**Simple circuits** • Introduce voltage (potential difference) in parallel and series circuits. • Reinforce resistance and how this can be changed in a circuit. • Introduce the relationship between I, R and V. • Introduce how resistance changes with current. • Introduce graphs showing current against voltage. • Introduce the change of resistance due to LDRs and resistors. • Introduce more complex calculations and analysis of circuits. • Introduce sensing circuits. • Introduce power and use power equations.	N/A
	Magnets	Magnetic materials, magnetic force **Elements, Mixtures and Compounds** • Introduce magnetic properties of metals. • Introduce examples of magnetic metals. **Forces** Introduce magnetism as a force.	**Earth and Space** • Introduce magnets and how they attract and repel. • Introduce the Earth's magnetic field, how it affects compasses and how to find the shape of a magnetic field.	**Newton's Laws** • Introduce magnetism as a non-contact force.	**Magnets and Magnetic Fields P3.3** • Reinforce permanent magnets and how they attract and repel. • Introduce the different between permanent and induced magnets. • Introduce magnetic field lines and how they relate to strength and direction. • Introduce the behaviour of a magnetic compass. **Magnets and Magnetic Fields P4 (Triple)** • **PHY ONLY: Introduce electromagnetic induction.** • **PHY ONLY: Introduce how generators work to produce AC and DC.** • **PHY ONLY: Introduce transformers.** • **PHY ONLY: Introduce transformer equation.** • **PHY ONLY: Introduce microphones and loudspeakers.** • **PHY ONLY:**	**Powering Earth P6.2 (P8.2 - triple)** • Introduce National Grid and how transformers are used. • Introduce mains electricity.
	Electromagnet	N/A	Describe an electromagnet, how to change its' strength .and some uses **Electromagnets** Magnetic fields • Introduce force fields • Introduce electromagnets, uses and how the strength can be changed. • Introduce motors.	N/A	**Static and Charge** • Introduce charge and static electricity. • Introduce the transfer of electrons between objects. • Reinforce current and how to measure it. **Simple circuits** • Introduce DC circuits. • Reinforce circuit symbols. **Magnets and Magnetic Fields** • Introduce the magnetic affect caused by a current. • Introduce solenoids. • Introduce the forces between a magnet and a conductor. • Introduce magnetic flux density and use the equation. • Introduce electric motors. •	N/A

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Science Curriculum Map – Substantive Knowledge Progression (KS5 Biology)

Organisms	Genetics	Ecosystems	Matter	Reactions	Earth	Energy	Forces	Waves	Electricity & Magnets

		Year 12	Year 13
Organisms		**Basic components of living systems** • Using microscopes to identify cellular structures. • Using an eyepiece graticule to measure cellular structures • Calculating magnification, image size or actual size from magnified images. **Biological molecules** • Identifying the different types of biological molecules in living organisms • Carrying out the scientific tests for biological molecules and identifying positive results • Describing the processes of DNA replication and protein synthesis **Enzymes** • Describing and explain the role of enzymes in organisms and their method of action. • Describing and explaining factors that can affect enzyme functioning. **Plasma Membranes** • Identifying the structural components of the plasma membrane and the factors that affect its fluidity. • Describing the movement of substances by diffusion, active transport, and osmosis. **Cell divisions** • Describe the role of the cell cycle • Describing the stages of mitosis and meiosis • Describing cell differentiation and the different types and uses of stem cells **Exchange surfaces and breathing** • Identifying the adaptations of the specialised exchange surfaces including the mammalian exchange surface • Know how to use a spirometer and identify the parts of a spirometer trace **Transport in animals** • Learn about the transport systems in multicellular organisms • Identify the adaptations of the blood vessels • Describe and explain the functioning of the heart and identify ECG readings • Describe the transport of oxygen and carbon dioxide **Transport in plants** • Transport systems in dicotyledonous plants • Water transport in multicellular plants including plant adaptations. • Transpiration and translocation **Communicable diseases** • Animal and plants pathogens and diseases • Transmission of communicable diseases • Plant and animal defence mechanisms • Specific and non-specific defences • Preventing and treating disease	**Neuronal communication** • Review the organisation and structure of the nervous system. • Describe tnervous transmission and the role of synapses • Identify the different types of muscles and explain the sliding filament model of muscle contraction • **Hormonal communication** • Describe the structure and function of the pancreas • Explain the regulation of blood glucose concentration • Describe how diabetes can be controlled • Describe how heart rate is controlled **Homeostasis** • Thermoregulation in endotherms and ectotherms • Describe the structure and function of the liver and kidneys(including the identification of structures from electron micrographs) • Describe how osmoregulation works • Urine, diagnosis and kidney failure **Plant responses** • Plant hormones, their role in growth and commercial uses • Plant responses to abiotic stress and herbivory • Explaining tropisms and how they are work **Energy for biological processes** • Describe ATP synthesis • Recall photosynthesis and the factors that affect its rate. **Respiration** • Learn the stages in respiration – glycolysis, link reaction, Krebs and oxidative phosphorylation • Anaerobic respiration in mammals and microorganisms • Respiratory substrates
Genetics		**Cell divisions** • The role of the cell cycle • The process of mitosis and meiosis	**Genetics of living systems** • Learn the different types of mutations and how they are linked to variation • Understand the control of gene expression • Body plans **Patterns of inheritance** • The different types of variation and inheritance • Monogenic and dihybrid inheritance – interpreting and conducting table crosses • Calculating phenotypic ratios

			• Evolution • Speciation and artificial selection **Manipulating genomes** • DNA profiling • DNA sequencing and analysis • Using DNA sequencing • Genetic engineering • Gene technology and ethics **Cloning and biotechnology** • Natural and artificial cloning in plants • Cloning in animals • Microorganisms and biotechnology • Microorganisms, medicines, and bioremediation • Culturing microorganisms in the laboratory and on an industrial scale • Using immobilised enzymes
Ecosystems		**Classification and evolution** • Recall the five kingdoms and identify features of each one • Phylogeny and how it is used • Describe the evidence for evolution • Variation • Changing populations **Biodiversity** • Recall the different sampling techniques • Calculating biodiversity • Identify the factors that affect biodiversity • Methods of maintaining biodiversity	**Ecosystems** • Ecosystems • Learn how biomass is transferred through an ecosystem • Recycling within ecosystems • Learn what Succession is • Measuring the distribution and abundance of organisms **Populations and sustainability** • Population size • Competition • Predator-prey relationships • Conservation and preservation • Sustainability • Ecosystem management – Masai Mara, Terai region of Nepal, and peat bogs • Environmentally sensitive ecosystems

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Science Curriculum Map – Substantive Knowledge Progression (KS5 Chemistry)

Organisms	Genetics	Ecosystems	Matter	Reactions	Earth	Energy	Forces	Waves	Electricity & Magnets

		Year 12	Year 13
Matter		**Atoms, Ions and Compounds** • Revise atomic and electronic structure, the formation of ions • Define the term relative atomic mass and model calculations using relative isotopic mass • **Amount of substance** • Revise the term mole and calculating the amount of substance using mass, in a solution and in a gas • Introduce the ideal gas eqaution including its limitations • Revise stoichiometry, % yield, atom economy and the term limiting reagent **Electrons and Bonding** • Introduce the terms energy level, principal quantum number and atomic orbital including the shapes of s and p orbitals • Model the rules used to fill orbitals and determine electronic structure • Model Ionic Bonding diagrams and use this model to explain physical properties of ionic compounds • Model Covalent Bonding diagrams **Shapes of Molecules and Intermolecular Forces** • Use electron pair repulsion theory to predict the shape and bond angle in different molecules • Learn the three types of IMFs between simple molecules and predict the relative melting and boiling point **Periodicity** • Learn trends across and down the periodic table such as first and successive ionisation energies, trends in reactivity and trends in melting and boiling points **Amount of substance** • Revise the term mole and calculating the amount of substance using mass, in a solution and in a gas • Introduce the ideal gas equation including its limitations • Revise stoichiometry, % yield, atom economy and the term limiting reagent **Reactivity Trends** • Revise the test for Carbonate, Sulfate and Halide ions. Explain why there is a correct order for performing these tests on an unknown substance **Spectroscopy** • Describe how Mass Spectroscopy and Infrared Spectroscopy can be used in the identification of organic molecules	**Acids, Bases and pH** • Model calculations to determine the pH of strong acids, weak acids, strong acids and buffer solutions **Transition Elements** • Compare the electronic structure of d block elements with s and p block elements. Use the differences in electronic structure to explain typical properties of transition elements
Reactions		**Atoms, Ions and Compounds** • Revise writing chemical formulae and modelling reactions through balanced symbol equations **Acids and Redox** • Revise the term dissociations and the ions that make a solution either acid or lkaline • Model typical reactions of acids both as general equations and ionic equations • Learn the practical techniques associated with preparing a standard solution and performing a titration and model typical calculations • Learn to calculate the oxidation number in different compounds and use oxidation numbers to model Oxidation, Reduction, Redox and disproportionation reactions **Reactivity Trends** • Model the typical reactions of group 2 metals with Oxygen, water and dilute acids. Explain differences in reactivity in terms of ionisation energies • Model the reaction of group 2 compounds giving commercial applications	**Rates of Reaction** • Use different techniques to determine the order of each reactant in an equation and use to form a rate equation and calculate the rate constant for a reaction • Use orders to predict a two step mechanism for simple reactions • Demonstrate how the Arrhenius equation can be written in the form y = mx + c and used to determine either the acitvation energy or the pre-exponential factor for a reaction **Equilibrium** • Model calculations to determine kc from reacting quantities including the derivation of appropriate units • Define the term mole fraction and using partial pressure calculate kp for a reaction including the derivation of appropriate units **Acids, Bases and pH** • Define the terms Bronsted-Lowery acid and Bronsted-Lowery base and model reactions of acids idetifying conjugate acid-base pairs • Predict pH curves for simple titrations and use the shape to suggest a suitable indicator for that reaction

		• Model the reactions of the halogens including displacement reactions, and reactions of Chlorine with water and with aqueous Sodium Hydroxide **Enthalpy** • Introduce the term enthalpy change including appropriate units • Model the enthalpy change of a reaction using enthalpy profile diagrams. Use these to model simple calculations of enthalpy change using average bond enthalpies • Describe different techniques used in calorimetry and model associated calculations • Define and model Hess' cycles **Reaction Rates and Equilibrium** • Revise collision theory as a basis to model the effect of different conditions on the rate of a rection. Draw and describe Boltzmann distribution curves as a basis to further visualise these effects • Revise the term equilibrium and use Le Chatilier's law as a basis to model the effect of temperature, pressure, concentration and the effect of a catalyst on the position of equilibrium. Introduce the term kc as a basis to quantify these changes **Alkanes** • Model equations for the complete and incomplete combustion of alkanes • Model the reaction of alkanes with halogens through the free radical substitution mechanism **Alkenes** • Model a range of addition reactions, particularly focussing on the electrophilic addition mechanism **Alcohols** • Model equations for the different oxidation reactions of alcohols producing aldehydes, ketones or carboxylic acids. Explain the different practical techniques used to produce either aldehydes or ketones **Haloalkanes** • Model the mechanism for nucleophilic substitution and the mechanism for the delpetion of ozone **Synthetic Routes** • Show how target molecules can be produced in multistep reactions	**Enthalpy and Entropy** • Define the term Lattice Enthalpy. Learn the different steps that can be sequenced together in a Born-Haber cycle to calculate a value for Lattice Enthalpy. • Define the term entropy. Learn to calculate the entropy change and the Gibbs Free Energy change for a given reaction **Redox and Electrode Potentials** • Model half equations for typical Oxidation and Reduction reactions and how these equations can be combined to determine an overall equation. Apply redox equations to examples of redox titrations • Define the term electrode potential (including how they are determined experimentally) and how they can be used to predict the products of redox reactions. Apply this understanding to the development of modern storgae cells. **Transition Elements** • Use equations to model the formation transition metals complexes using different ligansd and typical reactions including ligand substitution and precipitation reactions
Earth		**Basic concepts of Organic Chemistry** • Explain Crude Oil as the basis of almost all Organic compounds and the issues surrounding the sustainability of using associated products **Alkanes** • Explain the long term environmental impact of combustion of alkanes including the relationship between production of greenhouse gases and global warming, the formation and effects of Nitrogen Oxides and Sulfur Dioxide and the problems associated with incomplete combustion **Alkenes** • Explain problems associated with the disposal of Addition polymers and evaluate different alternate methods of disposal **Haloalkanes** • Discuss the consequences of depletion of the ozone layer	**Redox and Electrode Potentials** • Evaluate the development of modern storage cells as an alternative to the internal combustion engine **Stars** • Describe objects in our solar system and our universe. • Describe and explain the lifecycle of different sized stars • Use the Hetzsprung-Russell diagram to plot the life of various stars **Cosmology** • Describe the differences between different astronomical units and how to convert between them • Explain how evidence from the universe like the doppler effect, red shift and Cosmic Microwave Background Radiation support the theory of the Big Bang • Explain how the different theories surrounding the end of our universe. **Gravitational Fields** • Describe and apply Keplers 3 laws which govern the ways things like planets, stars and satellites orbit each other in the universe.
Energy	Motion	**Motion** • Work done by a force, the unit of Joule, principle of conservation of energy, kinetic and gravitational energy, power and efficiency	**Circular motion and Simple Harmonic Motion** • Explain the interchange between kinetic and potential energy in SHM, energy displacement graphs for SHM. The effects of damping a system. Free and forced oscillations. • Explain how energy is removed from oscillatory systems by using graphs and key terms like damping. • Describe the difference and use Equations to calculate Gravitational Potential energy and Gravitational Potential

	Materials	**Materials** • Elastic potential energy, How different materials deform and their physical properties. Youngs modulus of a material, how to calculate it.	
	Electrical	**Circuits** • Energy transferred in circuits W=VQ and W=EQ energy transfers for electrons and charged particles in an electron gun. Electrical power in circuits and energy loss and efficiency. The kilowatt hour and how we pay for energy. Conservation of electrical energy.	**Electric Fields** • Calculate the energy stored in a capacitor. Use a graph to calculate the energy stored in a capacitor. • Calculate and analyse the difference between Electric Potential energy and Electric Potential
	Thermal		**Thermal Physics** • Thermal equilibrium, the absolute scale of temperature and Kelvin. The kinetic model of matter, Brownian motion and the structure and movement of solids liquids and gases. Internal energy is the sum of kinetic and potential energy of particles in a system, absolute zero, temperature and internal energy, changing state. Specific heat capacity, specific latent heat of fusion and fission. • Amount of a substance and the mol, Avogadro's number, the gas laws and the ideal gas equation, the root mean square speed of particles in a gas. Boltzmann's constant

Prince William School

Science Curriculum Map – Substantive Knowledge Progression (KS5 Physics)

BIOLOGY			CHEMISTRY				PHYSICS		
Organisms	Genetics	Ecosystems	Matter	Reactions	Earth	Energy	Forces	Waves	Electricity & Magnets

		Year 12	Year 13
Forces	Motion	**Motion** • Average speed, instantaneous speed, distance time graphs, Displacement, velocity, displacement time graphs, Acceleration, and velocity time graphs, using velocity time graphs to calculate displacement, equations of motion, thinking, braking, and stopping distance, free fall of gravity, projectile motion, • Newtons 3 laws of motion, linear and vector nature of momentum, elastic, and inelastic collisions. The impulse of a force, and force-time graphs. 2d collisions,	**Circular motion and Simple Harmonic Motion** • The radian as a measure of an angle, period and frequency of circular motion, angular velocity. Centripetal force an acceleration, • Displacement, amplitude, frequency, angular frequency and phase difference in Simple Harmonic Motion (SHM), isochronous oscillators, analysing simple harmonic motion and velocity, amplitude and acceleration. Resonance and natural frequency, amplitude driving frequency for forced oscillators.
	Forces	**Forces** • Force causes acceleration, difference between mass and weight, centre of gravity, free body diagrams, drag and terminal velocity. The principle of moments, couples and torques, triangle of forces. Density and pressure, Archimedes' principle.	**Circular motion and Simple Harmonic Motion** • Derive the equation for centripetal acceleration. • Apply various equations to calculate the forces experience in circular motion. • Explain the issues surrounding resonance and the multiplication of forces on structures due to natural frequencies • Describe the gravitational field around an object and apply equations to calculate it. • Apply newtons law of gravitation **Magnetic Fields** • Calculate the forces on charged particle in a magnetic fields • Analyse movement of objects in a magnetic field and compare to projectile motion
	Materials	**Materials** • Tensile and compressive forces, Hooke's law, force constant of a spring, elastic and plastic deformation, force extension graph and elastic potential energy. Stress, strain, and ultimate tensile strength, Young modulus.	
Waves	Waves basics	**Waves** • Progressive waves, longitudinal and transverse waves, displacement, amplitude, wavelength, period, phase difference, frequency, and wave speed. Reflection, refraction, diffraction, and polarisation. Intensity of waves in relation to distance. • Stationary waves, nodes and anti-nodes. Harmonics and stationary waves on stringed instruments and woodwind instruments.	**Medical Physics** • Describe and analyse the use of sound waves in medical imaging.
	EM Waves	**EM Waves** • The order of the electromagnetic spectrum, properties of EM waves. Polarisation of EM Waves. Refractive index of light total internal reflectoin and critical angle, superposition, and interference. The Young double slit experiment.	**Medical Physics** • Describe and analyse the different ways you can use EM waves to image the body in various different ways.

	Quantum	**Quantum Physics** • Quantum nature of EM radiation, photons as quanta of energy, LEDs to calculate planks constant. Photoelectric effect, one to one interaction between photons and surface electrons, work funcrtion and threshold frequencies, the effects of intensity on the emission of photoelectrons. Wave paerticle duality, the diffraction of electrons the de Broglie wavelength.	**Stars** • Apply the understanding of the quantum nature of EM radiation, photons as quanta of energy to analyse what stars are made up of..
	Radioactivity		**Nuclear Physics** • Describe the subatomic particles that make up the world around us. • Explain the importance of the alpha scattering experiment and how that helped us discover what matter is made of and the nucleus of an atom • Describe the 3 types of nuclear radiation and the decays that an atom goes through • Describe the nature of Half-life and the equations that show radioactive decay • Describe how we can date an object using radioactive decay • Calculate the energy released in different nuclear interactions.
Electricity and Magnets	Charge	**Charge** • Current as the movement of charged particles, conventional and electron flow. Kirchhoff's laws, mean drift velocity, conductors, semi-conductors, and insulators.	**Capacitance** • Describe the term capacitance and the unit of farads • Calculate the capacitance of a charged plate. • Use an exponential graph to describe and calculate the discharging and charging of a capacitor. **Electric Fields** • Analyse electrical Fields
	Circuits	**Circuits** • Circuit symbols and how to draw circuits. Potential difference, electro motive force. Resistance and Ohm's law. I-V graphs for key components. Resistivity and resistance. Thermistors, LDRs and Diodes. Combining resistors in series and parallel. Internal resistance and lost volts. Potential dividers and sensing circuits.	**Capacitance** • Describe the effect of putting capacitors in different parts of a circuit and analyse the uses of capacitors
	Magnetism		**Magnetic Fields** • Explain how to generate a magnetic field. • Draw the magnetic field around different objects. • Apply Fleming's Rules to understand how magnetic fields are produced and what effect they have on objects. • Explain the effect on magnetic fields on charged particles. • Describe electromagnetic induction and analyse its uses. • Describe how transformers work and what use they have in everyday life.

Prince William School
Science Curriculum Map – Disciplinary Knowledge Progression

Answering Scientific Questions		Obtaining and Presenting Evidence			Considering Evidence and Evaluating	
Making a Hypothesis	Making Predictions	Setting up Experiments	Observing and Measuring	Recording Data	Interpreting and Communicating Results	Evaluating

	Key Stage 3	Key Stage 4	Key Stage 5
Answering Scientific Questions	• Planning valid investigations to test a hypothesis, ensuring only independent and dependent variables are changed and not those which are controlled	• Planning a valid investigation that reduces sources of error and planned to obtain precise, accurate and reproducible results	• Evaluate existing plans to find weaknesses in the plan and adapt them so they obtain valid results
Obtaining and Presenting Evidence	• Selecting appropriate equipment to obtain accurate measurements • Create data tables that record independent and dependant variables. These must include headings and units for the data recorded • Use simple data processing methods such as mean, median and mode • Construct bar charts, line and scatter graphs to present data from findings, and reason why that type of graph is appropriate • Identify anomalies in results	• Reason the choice of equipment being used, relating the choice to the resolution of the equipment • Create accurate tables that take account for repeats and means. Tables should include headings and units • Calculate averages and ranges to analyse the precision and accuracy of data recorded • Select and construct an appropriate form of graphical display for data, • Construct lines of best fit within graphs • Use additional formula in data processing • Identify and suggest the reason for anomalies	• Calculate the % error associated with equipment and suggest how the error can be reduced • Make adaptations to a given method to overcome unforeseen errors and improve accuracy of results • Construct appropriate results tables that allow all data to be recorded from practical work • Use statistical analysis to deduce the reliability of data produced • Obtain and use secondary data and source the data appropriately • Use graphical representations of data to support conclusions, • Use scientific reasoning for identifying and reducing anomalies
Considering Evidence and Evaluating	• Use results to make conclusions about patterns in the results • Link conclusions to the hypothesis being tested and reason whether it has been proved or disproved • Find errors in results (anomalies) and suggest how methods can be improved to reduce these errors	• Use data produced to prove or disprove a hypothesis and link these conclusions to scientific concepts • Describe relationships within graphs • Evaluate results and state the type and source of errors and how these can be reduced • Evaluate the precision, accuracy, reproducibility and repeatability of a practical	• Use a range of data, primary and secondary, to conclude whether a hypothesis is proved • Explain relationships within graphs linking to Scientific concepts • Predict sources of error prior to undertaking a practical and adapt the method to reduce these • Evaluate the reliability of sources of data • Use methods to confirm that data is statistically significant

Prince William School
Science Disciplinary Vocabulary

Progression of Vocabulary

From KS2		Key Stage 3	Key Stage 4	Key Stage 5
Variables	Independent variable	← Reinforce Previous	← Reinforce Previous	← Reinforce Previous
Control variable	Dependent variable	Hypothesis	Reproducible	Exponential
Identify	Accuracy	Continuous	Repeatable	Percentage Error / Uncertainty
Classify	Precision	Categoric	Trend	Primary Data
Order/rank	Degree of trust	Data	Correlation	Secondary Data
Comparative tests	Classification keys	Line of best fit	Positive	Source
Fair tests	Bar Chart	Axis	Negative	Referencing
Careful/systematic	Line graphs	Anomaly / anomalous result	Systematic Error	Reliability
Accurate	Opinion/fact	Error	Random Error	Extrapolate
Observations		Repeat	Zero Error	Quick fit equipment
Evidence		Average	Range	Buffer solution
Present		Mean	Resolution	Molarity/Concentration
Data/evidence/results		Valid test	Formula	Micrometre
Keys		Risk	Risk assessment	Multi-meter
Bar charts		Hazard	Conical flask	Statistical Analysis
Conclusions		Prevention	Condenser	T Test
Prediction		Bunsen Burner	Bias	Chi^2 Test
Support/not support/ refute		Measuring cylinder	Instrumental	Standard deviation
Thermometers		Beaker	Balance	Validity
Data loggers		Test Tube	Measuring Cylinder	
Magnifying glass		Scale/Balance	Gas syringe	
Microscope				
Increase				
Decrease				
Appearance				

Prince William School
Science Key Vocabulary

Organisms	Genetics	Ecosystems	Energy	Forces	Waves	Electricity and Magnets	Matter	Reactions	Earth

	Year 7		Year 8			Year 9		
Autumn 1	Particle Model	Electrical Circuits	Unicellular Organisms	Chemical Reactions	Fluids	Cell Structure	Atomic Model	
	Melting	Component	Unicellular	Reactant	Density	Eukaryote	Particle model	Nucleus
	Boiling	Current	Flagella	Product	Pressure	Prokaryote	Physical Change	Atomic Number
	Condensing	Ammeter	Bacteria	Equation	Upthrust	Plasmid	Chemical Change	Mass Number
	Freezing	Voltmeter	Protoctista	Exothermic	Brownian Motion	Light Microscope	Atoms	Isotope
	Sublimation	Conductor	Virus	Endothermic	Drag	Magnification	Protons	Ion
	Particles	Series	Fungi	Hydrocarbon	Air resistance	Image	Neutrons	Molecule
	Energy	Parallel	Asexual reproduction	Green House Gas	Streamline	Resolution	Electrons	Plum Pudding
	Diffusion	Fuse	Fermentation	Global Warming	Weight	Electron Microscope	Electron Shell	Chemical Symbol
Autumn 2	Forces	Elements, Mixtures and Compounds	Metals Rocks		Breathing and Respiration	Purity and Separating Mixtures	Changes of State	
	Contact Force	Atom	Minerals	Reactivity Series	Aerobic Respiration	Relative Atomic Mass	Density	
	Non-contact force	Element	Porous	Properties	Ventilation	Relative Formula Mass	Eureka Can	
	Friction	Mixture Compound	Permeable	Malleable	Cilia	Pure Substance	Specific heat capacity	
	Gravity	Chemical Bond	Cement	Ductile	Alveoli	Impure Substance	Internal energy	
	Elastic	Chromatography	Sedimentary	Oxidation	Bronchus	Rf Value	Latent heat of fusion	
	Upthrust	Distillation	Metamorphic	Rusting	Trachea	Mobile phase	Latent heat of vaporisation	
	Newtons	Filtering	Igneous	Displacement	Arteries / Veins	Stationary phase	Kelvin	
	Newton Meter	Reactants / Products	Errosion	Corrosion	Exothermic	Gas chromatography		
Spring 1	Cells	Sounds	Food and Nutrition		Energy Transfers	Respiration and Photosynthesis		
	Organelle	Vibration	Nutrients		Joules	Metabolic rate		
	Nucleus	Volume	Carbohydrate		Conduction	Aerobic		
	Cytoplasm	Pitch	Minerals		Convection	Anaerobic		
	Cell Membrane	Frequency	Vitamins		Radiation	Fermentation		
	Cell Wall	Amplitude	Protein		Insulator	Oxygen debt		
	Chloroplast	Decibels	Fibre		Conductor	Chlorophyll		
	Permanent Vacuole	Hertz	Malnutrition		Sanky Diagram	Limiting factor		
	Mitochondria	Vacuum	Enzyme		Payback time	Startch		
Spring 2	Sexual Reproduction	Acids and Alkalis	Plants and their Reproduction	Earth and Space	Light	Bonding and Property of Materials		
	Gametes	Acid	Flower	Solar System	Vacuum	Ionic Bond		
	Sperm	Alkali	Mitosis	Universe	Transverse	Giant Ionic Lattice		
	Ovum	Corrosive	Sexual reproduction	Galaxy	Longitudinal	Electrostatic Attraction		
	Oviduct	Indicator	Pollination	Seasons	Transparent	Covalent bonding		
	Ovary/ Ovaries	Litmus	Stamens	Satellite	Translucent	Intermolecular forces		
	Fertilisation	Neutralisation	Anther	Elliptical Orbit	Scattered	Giant covalent structure		
	Uterus	pH Scale	Filament	Weight	Angle of incidence	Simple molecules		
	Gestation	Universal Indicator	Style	Gravity	Reflected	Polymers		
	Puberty	**SAlt**	**Stigma**	**Hemisphere**	**Refraction**	**Delocalised electrons**		

Prince William School

Science Key Vocabulary Continued

Organisms	Genetics	Ecosystems	Energy	Forces	Waves	Electricity and Magnets	Matter	Reactions	Earth

	Year 7		Year 8		Year 9
Summer 1	Ecosystems	Energy	Genetics and Evolution	Electromagnets	Forces
	Community	Non-Renewable	Environmental	Current	Plastic
	Ecosystem	Nuclear	Inherited	Gravitational	Elastic
	Variation	Potential	Classification	Positive	Limit of proportionality
	Habitat	Kinetic	Continuous	Negative	Elastic limit
	Species	Gravitational	Discontinuous	Charge	Hooke's law
	Competition	Thermal	Species	Relays	Spring constant
	Hibernation	Electrical	Characteristic	Ohms	Pivot
	Migration	Efficiency	Zygote	Resistance	Moment
Summer 2	Muscles and Bones	Scientific Investigations	Scientific Investigations	Motion and Forces	Scaling Up
	Muscle	Independent Variable	Independent Variable	Balanced	Concentration gradient
	Contract	Dependent Variable	Dependent Variable	Unbalanced	Osmosis
	Antagonistic Pair	Control Variable	Control Variable	Resultant	Water potential
	Ligament	Prediction	Hypothesis	Accelerate	Active transport
	Tendon	Hypothesis	Continuous	Dissipated	Specialised
	Gas exchange	Categoric	Line Graph	Drag	Stem cell
	Inhalation	Bar chart	Line of best fit	Deformed	Meristem
	Exhalation	Conclusion	Anomalous Result	Conservation	DNA replication

Prince William School
Science Key Vocabulary

Organisms	Genetics	Ecosystems	Energy	Forces	Waves	Electricity and Magnets	Matter	Reactions	Earth

Year 10

The Challenges of Size		Introducing Chemical Reactions		Static and Charge	
Surface area:volume ratio	Vascular bundle	Molecular Formula	Mole	Charge	Proton
Exchange surface	Translocation	Empirical Formula	Avogadro's constant	Conventional flow	Static
Double circulatory system	Transpiration	Diatomic	Excess	Coulombs	Sparks
Cardiac muscle	Potometer	State Symbols	Limiting Reagrent	Electron	Milliamps
The Nervous System The Endocrine System		**Energetics**		**Simple Circuits**	
Reflex arc	Contraception	Exothermic	Reaction profile	Thermistor	LDR
neurone	Endocrine system	Endothermic	Bond energy	Diode	Light intensity
Cerebellum	Hormone	Energy change	Surroundings	Ohms	Linear
Cerebrum	Auxins	Activation Energy		Potential difference	Non-linear
Maintaining Internal Environments		**Types of Chemical Reaction**		**Magnets and Magnetic Fields Uses of Magnetism**	
Homeostasis	Diabetes	Redox	Reducing agent	Permanent	Tesla
Insulin	Water balance	Oxidation	Hydrogen ion	Induced	Domain
Glucagon	Medulla	Reduction	Hydroxide ion	Solenoid	Fleming's left-hand rule
Glycogen	Nephron	Oxidising agent	pH meter	Magnetic flux density	Field strength
Ecosystems		**Electrolysis**		**Wave Behaviour**	
Producer	Biotic	Electrolyte	Reactivity series	Electromagnetic wave	Oscilloscope
Consumer	Abiotic	Anode	Electroplating	Mechanical wave	Refraction
Decomposer	Interdependence	Cathode	Inert electrode	Longitudinal	Normal
Biomass	Mutualism	Molten	Half equation	Transverse	Resonance
Trophic level		Aqueous Solution		Wave velocity	
Inheritance		**Predicting & Identifying Reactions & Products**		**The Electromagnetic Spectrum**	
Genome	Heterozygous	Trend	Limewater	Spectrum	Gamma ray
Allele	Genotype	Alkali metal	Halide ion	Visible light	Radiographer
Dominant	Phenotype	Halogen	Instrumental method of analysis	Microwave	Thermogram
Recessive	Homozygous	Noble gas	Flame test	Radio wave	X-ray
Monitoring and Maintaining the Environment				**Radioactive Emissions**	
Sampling	Deforestation			Stable	Becquerels
Biodiversity	Random sampling			Unstable	Photon
Conservation	Non-random sampling			Geiger counter	Emission spectrum
Ecotourism	Seed bank			Penetrating powers	Ionising radiation

Year 11

Natural Selection and Evolution		Controlling Reactions		Work Done	
Natural selection	Phylogeny	Rate of Reaction	Successful Collision	Energy Stores	Electrically
Evolution	Species	Gas syringe	Concentration	Law of Conservation	Specific heat capacity
Antibiotic-resistance	Darwin	Tangent	Activation Energy	Closed system	Energy transfer
Classification	Extinction	Collision Theory	Catalyst	Mechanically	
Feeding the Human Race		**Equilibria**		**Power and Efficiency**	
Intensive/organic farming	Foreign genes	Hydrated	Backward reaction	Power rating	Dissipated
Biological control	Restriction enzyme	Anhydrous	Equilibrium position	Kilowatt-hour	Thermal conductivity
Hydroponics	Ligase enzyme	Equilibrium	Equilibrium yield	Lubrication	Efficiency
Gene pool	Genetically modified organism	Forward reaction	Closed system	Insulation	
Monitoring and Maintaining Health		**Improving Processes and Products**		**Physics on the Move**	
Antigen	Zone of inhibition	Fertilizers	Fermentation	Reaction time	Initial velocity
Phagocyte	Aseptic technique	Batch process	Hydration	Thinking distance	Final velocity
Lymphocyte	Clinical trial	Continuous process	Ore	Braking distance	Deceleration
Monoclonal antibodies	Placebo	Optimum conditions	Cryolite	Magnitude	
Non-Communicable Diseases		**Organic Chemistry**		**Powering Earth**	
Cancer	Organ transplant	Hydrocarbon	Alkene	Reserves	Direct voltage
Particulates	Immunosuppressant drugs	General formula	Fractional Distillation	National grid	Live wire
Ethanol	Embryonic stem cells	Saturated	Incomplete Combustion	Step-up transformed	Neutral wire
Cardiovascular disease	Gene therapy	Unsaturated	Bromine Water	Step-down transformer	Earth wire
Pacemaker		Alkane		Domestic supply	
Practical Skills		**Interpreting and Interacting with Earth Systems**		**Beyond Earth**	
		Atmosphere	Greenhouse gas	Red-shift	Asteroid belt
		Pollutant	Global warming	Big bang model	Lifecycle
		Acid rain	Carbon Capture	Cosmic microwave	Neutral satellite
		Particulates	Potable water	Background radiation	Artificial satellite
Revision		**Revision**		**Revision**	