Co-op Academy Swinton

Science Curriculum Overview

	Year 7	Year 8	Year 9	Year 10	Year 11
Autumn 1	Powerful Knowledge: Cells SoW: Cells **Substantive Knowledge:** Asking scientific questions; understanding risks and hazards; animal cells; plant cells; using microscopes; maths 1 and maths 2. **Disciplinary Knowledge:** identifying scientific and non-scientific questions; define and use the term hypothesis; describe a practical procedure; recognise and use expressions in decimal form; recognise scientific quantities; write a method including coherent and sensible order of steps and use SI units. **Working Scientifically:** reading a scale accurately; producing clear and labelled diagrams and obtaining a clear image using a light microscope. Powerful Knowledge: Particles SoW: Particles **Substantive Knowledge:** States of matter; the particle model; properties of matter; heating substances; melting and freezing; boiling and condensing; diffusion; variables; investigating diffusion; gas pressure; maths in science 3; density and measuring density. **Disciplinary Knowledge:** managing risk; identifying lab equipment; identifying variables in an investigation; suggesting and explaining hypotheses; substituting values into an equation and determining density. **Working Scientifically:** Measuring volumes of liquid accurately and safe use of heating devices.	Powerful Knowledge: Tissues and Organs SoW: Tissues and Organs **Substantive Knowledge:** The skeletal and muscular system; investigating muscle strength; the respiratory system; the mechanism of breathing; gas exchange; medicinal drugs; recreational drugs and organ donation debate **Disciplinary Knowledge:** identification and correct handling of any anomalous data; visualise and represent 2D and 3D forms; describe representative sampling techniques and apply representative sampling techniques **Working Scientifically:** measure and observe the effects of forces. Powerful Knowledge: Acids and Alkalis SoW: Acids and Alkalis **Substantive Knowledge:** The pH scale; indicators; indicators practical; neutralisation; making salts; writing methods; acids and metal carbonates and making salts from metal carbonates. **Disciplinary Knowledge:** Assess risk to include: a) identify hazard symbols and b) describe a sensible precaution to reduce risk; describe a practical procedure and include coherent and sensible order of steps with sufficient detail to obtain valid results. **Working Scientifically:** measure volumes of liquids correctly; measure pH; preparation of a pure dry sample of salt and measure mass accurately.	Powerful Knowledge: Growth and Differentiation SoW: Growth and Differentiation Substantive Knowledge: Eukaryotic and prokaryotic cells; aseptic technique; growth of bacteria; microscopes; observing cells; diffusion; diffusion in living things; osmosis; active transport; cell division; cancer and stem cells. Disciplinary Knowledge: Change the subject of an equation; use percentages; calculate percentage increase and decrease; identify variables in a given context; outline a simple ethical argument; explain there are hazards associated with science-based technologies; suggest a hypothesis and explain why it was chosen; identify and assess risks to health related to lifestyle habits and suggest sensible precautions to reduce risk. Working Scientifically: application of aseptic technique; prepare a slide with cells for viewing under a light microscope; obtain a clear image using a light microscope and measure mass accurately. Powerful Knowledge: The Periodic Table SoW: The Periodic Table Substantive Knowledge: Standard form, Orders of Magnitude, Atoms, Electronic Configuration, Isotopes, Understanding the Atom, The Periodic Table, The Noble Gases, The Alkali Metals, The Halogens, Reactions of the Halogens and The Transition Elements. Disciplinary Knowledge: Change the subject of an equation, Use percentages, calculate percentage increase and decrease, Identify in a given context: a. the independent variable as the one that is changed or selected by the investigator b. the dependent variable that is measured for each change in the independent variable, Outline a simple ethical argument about the rights and wrongs of a new development, discovery or technology, Explain that there are hazards associated with science-based technologies which have to be considered alongside the benefits, Suggest a hypothesis to explain given observations or data, Explain why a certain hypothesis was chosen, with reference to scientific theories and explanations, Identify and assess risks to health related to lifestyle habits and the risk of disease, Suggest sensible precautions to reduce risk Working Scientifically: Application of aseptic technique, Prepare a slide with cells for viewing under the light microscope, Obtain a clear image using a light microscope, Measure mass accurately	Powerful Knowledge:B1 Cell Biology SoW: Cell Biology **Substantive Knowledge:** Prokaryotes and eukaryotes, Calculating magnification, Observing cells, Cell specialisation, Mitosis and cell cycle, Stem cells, Diffusion, Diffusion in living organisms, Osmosis, Active transport *Separate Science: As above with the addition of Cultivating microorganisms* **Disciplinary Knowledge:** Use prefixes centi, milli, micro and nano. Recognise, draw and interpret images of cells. Use models and analogies to develop explanations of how cells divide. Evaluate the practical risks and benefits, as well as social and ethical issues, of the use of stem cells in medical research and treatments.Recognise, draw and interpret diagrams that model osmosis. *Separate Science: As above* **Working Scientifically:** Using a light microscope, investigating how surface area to volume ratio affects the rate of diffusion, investigating how the concentration of a solution affects the mass of potato. *Separate Science: As above with the addition, use aseptic techniques to plate a bacterial culture and investigate the effectiveness of antibiotic / antiseptic disks.* Powerful Knowledge: C1 Atomic Structure and The Periodic Table SoW: Atomic Structure and the Periodic Table **Substantive Knowledge:** Atomic structure / subatomic particles, Atomic structure development, Atoms, mixtures and compounds, Chromatography, Distillation, Development of the periodic table, Electron configuration, Metals and non-metals, Group 1, Group 7, Group 0 *Separate Science: Same as above with the addition of Transition metals* **Disciplinary Knowledge:** Safe use of a range of equipment to separate chemical mixtures. Use SI units and the prefix nano. Recognise expressions in standard form. Represent the electronic structures of the first twenty elements of the periodic table in both forms. Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects. *Separate Science: Same as above*	Powerful Knowledge: Rate and Extent of Chemical Change SoW: Rate and Extent of Chemical Change **Substantive Knowledge:** Calculating rates of reactions, Factors which affect the rates of chemical reactions, collision theory and activation energy, Catalysts, Reversible Reactions, Energy changes and reversible reactions, Equilibrium, The effect of changing conditions on equilibrium. *Separate Science: Same as above* **Disciplinary Knowledge:** Recognise and use expressions in decimal form, Use ratios, fractions and percentages. Translate information between graphical and numeric form. Drawing and interpreting appropriate graphs from data to determine rate of reaction. Plot two variables from experimental or other data. Determine the slope and intercept of a linear graph. *Separate Science: Same as above* **Working Scientifically:** Investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced and a method involving a change in colour or turbidity. Investigating reversible reactions. Investigating the effect of catalysts. *Separate Science: Same as above* Powerful Knowledge: Forces SoW: Forces **Substantive Knowledge:** Scalar and vector quantities, contact and non-contact forces, gravity, resultant forces, work done and energy transfer, forces and elasticity, describing motion along a line, distance and displacement, speed, velocity, The distance-time relationship, Acceleration, Newton's First Law, Newton's second law, Newton's third law, stopping distance, reaction time, factors affecting braking distance, momentum. *Separate Science: Same as above* **Disciplinary knowledge:** Apply and recall equations to calculate: Weight, work done, spring constant, speed, distance, acceleration, momentum extension of a spring, elestic potential energy. Recognise and be able to use the symbol for proportionality, ∝. Use ratios and proportional reasoning to convert units and to compute rates. Measure the effect of distractions on reaction time. *Separate Science: Same as above*

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				Working Scientifically: Use a variety of models to develop scientific explanations. Plan experiments or devise procedures to make observations, test hypotheses and check data. Use SI units (eg kg, g, mg; km, m, mm; kJ, J) unless inappropriate. *Separate Science: Same as above* Powerful Knowledge: P1 Energy SoW: Energy Substantive knowledge: Energy stores and systems, Power, Gravitational potential energy, Elastic potential energy, Kinetic energy, Specific heat capacity, Conservation of energy / energy wastage, Investigating insulation, Reducing energy wastage, Efficiency, Non-renewable resources, Renewable resources *Separate Science: Same as above* Disciplinary knowledge:Students should be able to recall and apply a variety of equations to calculate different stores of energy in objects. Investigate the transfer of energy from a gravitational potential energy store to a kinetic energy store. Investigate thermal conductivity using rods of different materials. Students may be required to calculate or use efficiency values as a decimal or as a percentage. *Separate Science: Same as above* Working Scientifically: Investigate the specific heat capacity of one or more materials Use prefixes for orders of magnitude).Use SI units unless inappropriate. Interconvert units. Use an appropriate number of significant figures in calculation. Appreciate the power and limitations of science and consider any ethical issues which may arise. *Separate Science: Same as above*	Working Scientifically: Investigate the relationship between force and extension for a spring. Investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on the acceleration produced by a constant force. Measure the effect of distractions on reaction time. Investigate collisions between laboratory trollies using light gates, to measure and record data. *Separate Science: Same as above* Powerful Knowledge: Homeostasis SoW: Homeostasis Substantive Knowledge: Homeostasis, The human nervous system, Human endocrine system, Control of blood glucose concentration, Hormones in human reproduction, Contraception, (HT) - The use of hormones to treat infertility, Feedback systems. *Separate Science: Same as above with the addition of the eye and the brain and kidneys* Disciplinary Knowledge: Evaluate information around the relationship between obesity and diabetes. Show why issues around contraception cannot be answered by science alone. Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications. Understand social and ethical issues associated with IVF and fertility treatments. Interpret and explain simple diagrams of negative feedback control. *Separate Science: Same as above* Working Scientifically: Plan and carry out an investigation into the effect of a factor on human reaction time. *Separate Science: Same as above*
Autumn 2	Powerful Knowledge: Forces SoW: Forces Substantive Knowledge: Force and unbalanced forces, and interaction pairs. Accuracy and precision, resultant forces, interaction pairs choosing a suitable scale, springs and deformation, drag forces and friction, investigating friction. Disciplinary Knowledge: Describe force as an interaction between objects measured in Netwons., Understand the difference between contact and non-contact forces, name non-contact forces. Understand drag, friction, and tension forces. Understand forces have a size and a direction. Understand resultant forces and balanced forces, that an object can experience two (balanced) forces and be stationary or moving at a constant speed. Unbalanced forces change, speed, shape and direction. Understand interaction pairs. Define elastic and elastic deformation and elastic limit. How force relates to extension. Understand drag as an opposing and opposite force, difference between drag and friction.	Powerful Knowledge: Movement and Pressure SoW: Movement and Pressure Substantive knowledge: Calculating mean, median, mode. Speed, Changing speed, Distance time graphs, Pressure and application of pressure Disciplinary knowledge: Calculate speed, use speed equation, Understand acceleration as changing speed. Understand how r motion is relative to the observer. Use distance time graphs to describe motion, plot distance time graphs, calculate speeds from distance time graphs. Define pressure and the link between area, force and pressure. Working scientifically: Calculating mean, median, mode. Measuring time, measurements to calculate speed, calculate speed and acceleration, interpret and draw conclusions from graphs, calculate surface areas. Powerful Knowledge: Respiration and Photosynthesis	Powerful Knowledge: Acceleration SoW: Acceleration Substantive knowledge: Resultant Vectors, Resolving Vectors, Newton's Third Law, Newton's First Law, Acceleration, Acceleration Investigation, Linear Graphs, Velocity-Time Graphs and Acceleration Problems. Disciplinary knowledge: Understand that y=mx + c represents a linear relationship, change the subject of an equation, determine the slope and intercept of a linear graph, understand the physical significance of area between a curve and the x-axis and measure it by counting squares as appropriate, any anomalous values should be examined to try to identify the cause and, if a product of a poor measurement, ignored and recognise the importance of scientific quantities and understand how they are determined. Working scientifically : Measure time accurately, measure motion, including determination of speed and rate of change of speed (acceleration/deceleration) and plot two variables	Powerful Knowledge C2: Structure and Bonding SoW: Structure and Bonding Substantive Knowledge: States of matter, Atoms and ions, Ionic bonding, Ionic compounds, Covalent bonding, Covalent compounds, Allotropes of carbon, Metallic bonding, *Separate Science: Same as above with the addition of Nanoparticles and Nanoparticles properties* Disciplinary Knowledge: Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects. Recognise substances as small molecules, polymers or giant structures from diagrams showing their bonding. Recognise substances as metallic giant structures from diagrams showing their bonding. *Separate Science: Same as above*	Powerful Knowledge: Organic Chemistry SoW: Organic Chemistry Substantive Knowledge: Crude oil, hydrocarbons and alkanes, Fractional distillation and petrochemicals, Properties of hydrocarbons, Cracking and alkenes, *Separate Science: Same as above* Disciplinary Knowledge: Make models of alkane molecules using the molecular modelling kits. Investigate the properties of different hydrocarbons. *Separate Science: Same as above* Powerful Knowledge: Chemistry of the Atmosphere SoW: Chemistry of the Atmosphere Substantive Knowledge: Early Atmosphere, Evolution of modern atmosphere, Greenhouse Effect, Global Warming and Climate Change, Carbon Footprint, Atmospheric Pollutants

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	Working scientifically: Define and understand the difference between accuracy and precision. Choose a suitable scale for a graph. Measure and observe the effects of forces. Powerful Knowledge: Reproduction SoW: Reproduction Substantive Knowledge: Sexual reproduction, asexual reproduction, puberty and reproductive system, menstrual cycle, embryo development, plant reproduction, presenting data, plant reproduction, seed dispersal, seed dispersal. Disciplinary Knowledge: Definition of gamete, key features of sexual reproduction, compare plant and animal; gametes. Define asexual reproduction, identify key features of asexual reproduction, compare processes of sexual and asexual reproduction. State the changes that occur during puberty, state the parts of the male and female reproductive system and state their purpose. State the definition of a hormone. Define pollination. Define male and female gametes in a flower, dissect a flower and name the parts. State definition of germination, describe the process of plant fertilisation. Recall methods of seed distribution. Explain how a seed ios adapted to its method of distribution. Working scientifically: construct a data table, describe features of a good data table. Investigate wing length v's distance travelled for seeds	SoW: Respiration and photosynthesis Substantive Knowledge: Lifestyle Habits and Risks, Aerobic Respiration, Anaerobic Respiration, Exercise and Respiration, Investigating Muscle Fatigue, Uses of anaerobic respiration, Photosynthesis, Investigating photosynthesis, Plant adaptations, non-photosynthetic plants, Biodomes. Disciplinary Knowledge: Calculate areas of triangles and rectangles, surface areas and volumes of cubes. Define the terms precise, accurate and valid, and be able to use these terms in the context of data. Decide on a suitable scale for x and y-axis when drawing a graph. Use an appropriate number of significant figures Working Scientifically: Measure time accurately. Read a scale accurately. Observing and measuring biological changes and/or processes, including safe and ethical use of living organisms. Identify and assess risks to health related to lifestyle habits and the risk of disease. Suggest sensible precautions to reduce risk. Any anomalous values should be examined to try to identify the cause and, if a product of a poor measurement, ignored.	from experimental or other data. Powerful Knowledge: Human Interaction SoW: Human Interaction Substantive knowledge: Biodiversity, how Humans affect Biodiversity, how Humans can Preserve Biodiverity, the Effect of Pollution on Biodiversity, Global Warming, "Taking it Further: Pyramids of Biomass" "Talking it Further: Farming and Biotechnology, "Taking it Further: Food Security. Disciplinary knowledge: Explain why data is needed to answer scientific questions, and why it may be uncertain, incomplete or not available, understand the principles of sampling as applied to scientific data, recognise that scientific methods and theories change over time, describe and explain specified examples of the technological applications of science, describe and evaluate, with the help of data, methods that can be used to tackle problems caused by human impacts on the environment and outline a simple ethical argument about the rights and wrongs of a new development, discovery or technology. Working scientifically: Measure the population size of a common species in a habitat. Use sampling techniques to investigate the effect of a factor on the distribution of this species.	Powerful Knowledge: B2 Organisation SoW: Organisation Substantive Knowledge: Principles of organisation, Digestive system, Food test 1 (Required prac), Food test 2 (Required prac), Enzymes theory, Enzymes (required prac), Heart and blood, Blood vessels, Coronary heart disease, Health, Lifestyle and effect on health, Cancer, Plant tissues / organs, Transpiration, Graph skills (linked to plant organs) *Separate Science: Same as above* Disciplinary Knowledge: Use percentages and calculate percentage gain and loss of mass of plant tissue. Use simple compound measures of rate of water uptake. Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. *Separate Science: Same as above* Working Scientifically: Use qualitative reagents to test for a range of carbohydrates, lipids and proteins. To include: Benedict's test for sugars; iodine test for starch; and Biuret reagent for protein. Investigate the effect of pH on the rate of reaction of amylase enzymes. Students should use a continuous sampling technique to determine the time taken to completely digest a starch solution at a range of pH values. Iodine reagent is to be used to test for starch every 30 seconds. Temperature must be controlled by use of a water bath or electric heater. *Separate Science: Same as above* Powerful Knowledge C3: Quantitative Chemistry SoW: Quantitative Chemistry Substantive Knowledge: Conservation of mass / formula mass, Balancing equations / closed systems, Moles and Avogadro (higher), Balancing equations using moles, Reacting masses, *Separate Science: Same as above with the addition of Atom economy, Yield , Limiting reactants, Gases volume* Disciplinary Knowledge: Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater. Safe use and careful handling of gases, liquids and solids, including careful mixing of reagents under controlled conditions, using appropriate apparatus to explore chemical changes. Representing distributions of results and make estimations of uncertainty. Use an appropriate number of significant figures in calculation. *Separate Science: Same as above with the addition*	*Separate Science: Same as above* Disciplinary Knowledge: use ratios, fractions and percentages, Understand how scientific methods and theories develop over time. Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. Appreciate the power and limitations of science and consider any ethical issues which may arise. Presenting reasoned explanations including relating data to hypotheses. *Separate Science: Same as above* Working Scientifically: Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences. Powerful Knowledge: Waves SoW: Waves Substantive Knowledge: Transverse and longitudinal waves, Properties of waves, Types of electromagnetic waves, Properties of electromagnetic waves, Uses and applications of electromagnetic waves, *Separate Science: Same as above* Disciplinary Knowledge: Apply the equation: period = 1 / frequency. Recall and apply the equation: wave s peed = f requency × wavelength *Separate Science: Same as above* Working Scientifically: Make observations to identify the suitability of apparatus to measure the frequency. Wavelength and speed of waves in a ripple tank and waves in a solid and take appropriate measurements. Investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface. *Separate Science: Same as above*

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				Working Scientifically: (Separate Science ONLY:) determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration. (HT only) determination of the concentration of one of the solutions in mol/dm3 and g/dm3 from the reacting volumes and the known concentration of the other solution.	

Spring 3	Powerful Knowledge: Atoms, Elements and Compounds SoW: Atoms, Elements and Compounds Substantive Knowledge: Mean and range, elements, atoms, periodic table, metals and non-metals, reactivity of metals, compounds, naming compounds, making iron sulphide, chemical formulae. Disciplinary Knowledge: Find the arithmetic mean and range of a set of data. Recognise and use expressions in decimal form. Draw conclusions from given observations. Draw conclusions from a graph. Draw conclusions from a table. Describe a practical procedure for a specified purpose. Include a coherent and sensible order of steps, with sufficient detail to obtain valid results, including suggested equipment Scientific thinking: Measurement of rates of reaction by a variety of methods including production of gas, uptake of water and colour change of indicator. Observing reactivity of metals, recording and interpreting observations. Understand hazard symbols and precautions needed when using hazardous materials Powerful Knowledge: Space and Gravity SoW: Space and Gravity Substantive Knowledge: Gravity, Mass and Weight, Keeping in Orbit, Bar charts, Pie charts and Histograms, Solar System, Satellites, Seasons, Eclipses. Disciplinary Knowledge: Use an appropriate number of significant figures. Find the arithmetic mean and range of a set of data. Substitute numerical values into algebraic equations using appropriate units for physical quantities. Solve simple algebraic equations Working Scientifically: Measure and observe the effects of forces including the extension of springs. Construct and interpret frequency tables and results tables. Consider the best way to present data. Decide on a suitable scale for x and y-axis when drawing a graph. Construct and interpret bar charts, pie charts and histograms	Powerful Knowledge: Changing Substances SoW: Changing Substances Substantive knowledge: Chemical changes, Conservation of mass, Balancing equations, Oxidation and reduction, Burning magnesium, reactions with acids, testing for gases. Disciplinary knowledge: Repeatable means the investigation can be repeated using the same method and equipment and obtains the same results. Reproducible means if the investigation is repeated by another person, or by using different equipment or techniques, the same results are obtained. Working scientifically: Measure mass accurately, measure pH, Use of appropriate qualitative reagents and techniques to analyse and identify unknown samples or products including gas tests, flame tests, precipitation reactions, and the determination of concentrations of strong acids and strong alkalis Powerful Knowledge: Magnetism SoW: Magnetism Substantive Knowledge: Magnetism, Magnetic Fields, Electromagnets, Investigating Electromagnets, Investigating Electromagnets Analysis, Earth's Magnetic Field Disciplinary Knowledge: Induced magnets are materials that become magnetic when placed in a magnetic field and lose their magnetism when removed. When a current flows through a conducting wire a magnetic field is produced around the wire. A solenoid is a coil of wire with a current flowing through it. An electromagnet is a solenoid with an iron core. The strength of the magnetic field around a solenoid is increased by adding more turns in the coil, adding a magnetic material as a core or increasing the current. The strength of the magnetic field depends on the current through the wire, the number of turns in the coil, the core material and the distance from the wire. An electromagnet can be turned off when there is no current flowing through it Working Scientifically: Visualise and represent 2D and 3D forms including 2 dimensional representations of 3D objects	Powerful Knowledge: Introduction to Quantitative Chemistry SoW: Introduction to Quantitative Chemistry Substantive Knowledge: Relative Formula Mass, Percentage by Mass, Conservation of Mass, Balancing equations, Uncertainty, Introducing concentration, concentration calculations, salts, making insoluble salts. Disciplinary Knowledge: Apply the idea that whenever a measurement is made, there is always some uncertainty about the result obtained. Use the range of a set of measurements about the mean as a measure of uncertainty. Interconvert units. Change the subject of an equation. Describe a practical procedure for a specified purpose. Include a coherent and sensible order of steps, with sufficient detail to obtain valid results, including suggested equipment. Working Scientifically: Safe use of equipment to separate mixtures using evaporation. Safe use of equipment to separate mixtures using filtration. Safe use of equipment to separate mixtures using crystallisation. Measure volumes of liquids accurately. Measure mass accurately. Preparation of a pure dry sample of a soluble salt	Powerful Knowledge: P2: Electricity SoW: Electricity Substantive Knowledge: KS3 Electricity recap, Current and charge, Potential difference and resistance, Series and parallel (current, P.D), Resistance in series and parallel, Resistance in a wire (required prac), IV characteristics 1 (required prac), IV characteristics 2 (required prac), Mains electricity, Power and energy transfers, Energy stores and systems, The National grid, *Separate Science: Same as above with the addition of Static electricity, Electric fields.* Disciplinary Knowledge: Substitute numerical values into algebraic equations using appropriate units for physical quantities. use circuit diagrams to construct and check series and parallel circuits including a variety of common circuit elements. Use appropriate apparatus to measure current, potential difference and resistance. *Separate Science: Same as above* Working Scientifically: Use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. Use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements *Separate Science: Same as above* Powerful KnowledgeB3: Infection and Response SoW: Infection and Response Substantive Knowledge: Infectious diseases, VIral and bacterial disease, Fungal and protist disease, Primary defence mechanisms, The immune response, Vaccination, Painkillers and antibiotics, Drug development, Plant disease, Plant disease response *Separate Science: Same as above with the addition of* Monoclonal antibodies Disciplinary Knowledge: Evaluate the global use of vaccination in the prevention of disease, Understand that the results of testing and trials are published only after scrutiny by peer review. *Separate Science: Same as above* Working Scientifically: Investigate the efficacy of antibiotics or antibacterial substances. *Separate Science: Same as above*	Powerful Knowledge: Inheritance and Evolution SoW: Inheritance and Evolution Substantive Knowledge: Sexual and asexual reproduction, Meiosis, , DNA and the genome, Genetic inheritance, Inherited disorders, Sex determination, Variation, Evolution, Selective breeding, Genetic engineering, Evidence for evolution, Fossils, Extinction, Resistant bacteria, Classification of living organisms. Disciplinary Knowledge: Modelling behaviour of chromosomes during meiosis.Appreciate that embryo screening and gene therapy may alleviate suffering but consider the ethical issues which arise.Use the theory of evolution by natural selection in an explanation. Explain the benefits and risks of selective breeding given appropriate information and consider related ethical issues.Interpret information about genetic engineering techniques and to make informed judgements about issues concerning cloning and genetic engineering, including GM crops.Data is now available to support the theory of evolution.Extract and interpret information from charts, graphs and tables.Appreciate why the fossil record is incomplete.Understand how scientific methods and theories develop over time. Interpret evolutionary trees. Powerful Knowledge: Using Resources SoW: Using Resources Substantive Knowledge: Using Resources and sustainability, Potable Water, Potable Water RP, Waste Water Treatment, Alternative Methods of Extracting Metals, Life Cycle Assessments, Recycling, Corrosion and Prevention, Alloys and Polymers, Glass, Ceramics, and Composites, Haber Process, Le Chateliers Principle, NPK fertilisers Disciplinary Knowledge: Translate information between graphical and numeric form. Recognise and use expressions in decimal form. Make estimates of the results of simple calculations. Interpret LCAs of materials or products given appropriate information. Compare the properties of thermosetting and thermosoftening polymers. Prepare an ammonium salt. Investigate the conditions for rusting. Working Scientifically: Analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.

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Spring 4	Powerful Knowledge: Interdependence SoW: Interdependence **Substantive Knowledge:** Random and Systematic Sampling, Practical Sampling Skills, Maths in Science - Linear Graphs, Measuring Plant Distribution, Food Chains and Webs, Trophic Levels, Biotic and Abiotic Factors, Competition, Ecosystems **Disciplinary Knowledge:** Know the difference between a scientific question and a non-scientific question (a question that science can answer). Define and understand the term hypothesis. Describe a practical procedure for a specified purpose. Recognise and use expressions in decimal form. Recognise the importance of scientific quantities and understand how they are determined. Include a coherent and sensible order of steps, with sufficient detail to obtain valid results, including suggested equipment. Use SI units. **Working Scientifically:** Read a scale accurately. Produce clear, labelled scientific drawings. Obtain a clear image using a light microscope	Powerful Knowledge: Life Diversity SoW: Life Diversity **Substantive Knowledge:** Variation, Inheritance, Maths in Science - Fractions, Maths in Science - Percentages, Artificial Selection, Natural Selection, Evolution, Human Impact on Natural Selection **Disciplinary Knowledge:** Use fractions. Use percentages. Calculate percentage increase and decrease. Construct and interpret frequency tables and results tables. Considering the best way to present data Powerful Knowledge: Earth Systems SoW: Earth Systems **Substantive Knowledge:** Igneous Rocks, Sedimentary Rocks, Metamorphic Rocks, The Rock Cycle, The "Choc" Cycle, The Water Cycle, Water and Living Things, Air Pollution **Disciplinary Knowledge:** Understand that all materials are cycled on Earth, as new matter cannot be created. Describe processes involved with different nutrient cycles, and how this impacts living organisms. Describe and explain specified examples of the technological applications of science. **Working Scientifically:** Obtain a clear image using a light microscope. Determine densities of solid and liquid objects	Powerful Knowledge: Heating SoW: Heating **Substantive Knowledge:** Using equations, Internal energy, Thermal transfers, specific heat capacity, specific latent heat. **Disciplinary Knowledge:** Change the subject of an equation. Any anomalous values should be examined to try to identify the cause and, if a product of a poor measurement, ignored. **Working Scientifically:** investigate and determine the specific heat capacity of different materials. Powerful Knowledge: Genetics SoW: Genetics **Substantive Knowledge:** Intro to DNA and Mitosis, Chromosomes, Genes and DNA, Meiosis, Evaluating Types of Reproduction, Development of Gene Theory, Determining Characteristics, Genes and Alleles, Determining Characteristics, DNA and Proteins, Punnett Squares - Genetic Disorders, Sex Cells - Punnett Squares, Continuous and Discontinuous Variation, Natural Selection, Competition and Extinction **Disciplinary Knowledge:** Describe and explain how technological advances in science have allowed scientists to understand the genome of living organisms. Interpret punnett squares to predict the characteristics of offspring from different parents. Understand and use key scientific vocabulary such as: genotype, phenotype, heterozygous and homozygous. Modelling behaviour of chromosomes during fertilisation, and describing how this leads to variation in offspring produced during sexual reproduction.	Powerful Knowledge: C4 Chemical Changes SoW: Chemical Changes **Substantive Knowledge:** Chemical reactions and physical changes, Metal oxides, Reactivity series, Metal and acid reactions, Metal carbonate reactions, pH scale, Strong and weak acids (higher), Soluble salts (required prac), Acids and alkalis, Neutralisation reactions, , Electrolysis 1, Electrolysis 2, Electrolysis 3 *Separate Science: Same as above with the addition of Titrations*) **Disciplinary Knowledge:** Mixing of reagents to explore chemical changes and/or products. Investigate pH changes when a strong acid neutralises a strong alkali. Measure the pH of different acids at different concentrations. Make order of magnitude calculations. Safe use and careful handling of gases, liquids and solids, including careful mixing of reagents under controlled conditions, using appropriate apparatus to explore chemical changes. Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. *Separate Science: Same as above* **Working Scientifically:** Preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution. Investigate what happens when aqueous solutions are electrolysed using inert electrodes. This should be an investigation involving developing a hypothesis. *Separate Science: Same as above with the addition of determination of the concentration of one of the solutions in mol/dm3 and g/dm3 from the reacting volumes and the known concentration of the other solution and determination of the reacting volumes of solutions of a strong acid and a strong alkali by titration.* Powerful Knowledge:P3 Particle Model of Matter SoW: Particle Model of Matter **Substantive Knowledge:** Particle models, Density theory, Density required prac, Changes of state / internal energy, Specific latent heat *Separate Science: Same as above with the addition of Gas pressure* **Disciplinary Knowledge:** Students should be able to recall and apply the density equation to changes where mass is conserved. Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. Translate information between graphical and numeric form. Use, in a safe manner, appropriate apparatus to measure energy changes/transfers and associated values such as work done. Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions. *Separate Science: Same as above*	Powerful Knowledge: P7 Magnetism and Electromagnetism SoW: Magnetism and Electromagnetism **Substantive Knowledge:** Poles of a magnet, Magnetic fields, Electromagnetism, Fleming's left-hand rule (HT only), Electric motors (HT only) **Disciplinary Knowledge:** Students should be able to apply this equation: force = magnetic flux density × current × length **Working Scientifically:** Investigate the behaviour of magnets. Powerful Knowledge: Space Physics SoW: Space Physics **Substantive Knowledge:** Space and the Solar System, Orbits and Satellites, Lifecycle of a Star, Red-Shift **Disciplinary Knowledge:** Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts. Appreciate the power and limitations of science and consider any ethical issues which may arise.

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				Working Scientifically: Use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solid objects and liquids. Volume should be determined from the dimensions of regularly shaped objects, and by a displacement technique for irregularly shaped objects. Dimensions to be measured using appropriate apparatus such as a ruler, micrometre or Vernier callipers. *Separate Science: Same as above*	
Summer 5	Powerful Knowledge: Mixtures SoW: Mixtures Substantive Knowledge: Mixtures, Solutions, Melting, Boiling and Purity, Separation of Mixtures, Filtration and Crystallisation, Fractional Distillation, Chromatography Disciplinary Knowledge: Describe, suggest or select the technique, instrument, apparatus or material that should be used for a particular purpose, and explain why. Select the best procedure from given options. Explain why a given practical procedure is well designed for its specified purpose. Apply understanding of apparatus and techniques to suggest a procedure for a specified purpose. Assess risk, to include: a. Identify hazard symbols b. Describe sensible precautions to reduce risk Identify names and uses of basic lab equipment and apparatus Working Scientifically: Measure volumes of liquids accurately. Measure temperature accurately. Safe use of equipment to separate mixtures using evaporation. Safe use of equipment to separate mixtures using filtration. Safe use of equipment to separate mixtures using crystallisation. Safe use of equipment to separate mixtures using chromatography. Safe use of equipment to separate mixtures using distillation. Plot two variables from experimental or other data. Produce clear, labelled scientific drawings. Safe use of heating devices and techniques, including Bunsen burner, electric heater and water bath Powerful Knowledge: Energy Transfers SoW: Energy Transfers Substantive Knowledge: Energy, Energy Stores, Energy Transfers, Energy in Food, Wasted Energy, Efficiency, Heat, Temperature and Thermal Energy, Temperature and Particles, Conductors and Insulators Disciplinary Knowledge: Describe, suggest or select the technique, instrument,	Powerful Knowledge: Resistance SoW: Resistance Substantive Knowledge: Resistance, Maths in Science - Significant Figures, Ohm's Law, Maths in Science, Measuring Resistance, Resistance in a Wire, Resistance in Series and Parallel, Applications of Resistance Disciplinary Knowledge: Change the subject of an equation. Describe mathematical relationships in terms of proportionality. Describe and explain specified examples of the technological applications of science. Describe and evaluate, with the help of data, methods that can be used to tackle problems caused by human impacts on the environment. Working Scientifically: Use of appropriate apparatus to measure current, potential difference (voltage) and resistance, and to explore the characteristics of a variety of circuit elements. Use of circuit diagrams to construct and check series and parallel circuits including a variety of common circuit elements Powerful Knowledge: Nutrition SoW: Nutrition Substantive Knowledge: Diet and Nutrition, Food Tests, Food Samples, The Digestive System, The Small Intestine, Models in the Digestive System, Enzymes, Digestive Enzymes, Investigation Amylase, Plant Nutrition Disciplinary Knowledge: Use of appropriate techniques and qualitative reagents to identify biological molecules and processes in more complex and problem-solving contexts, including continuous sampling in an investigation.Critique and evaluate models, including: Make predictions or calculate quantities based on the model or show its limitations.Give examples of ways in which a model can be tested by observation or experiment.Evaluate the strengths and limitations of a model Working Scientifically: Safe use of heating devices and techniques, including Bunsen burner, electric heater and water bath.	Powerful Knowledge: Using Resources SoW: Using Resources Substantive Knowledge: Reactions of Metals, Observing Reactivity, Using the Reactivity Series, Treating Water, Using Materials, Life Cycle Assessments, Reduce Reuse Recycle, Evaluating Impact, Sources of Information, Reactions of Metals, Observing Reactivity, Using the Reactivity Series, Treating Water, Using Materials, Life Cycle Assessments, Reduce Reuse Recycle, Evaluating Impact, Sources of Information Disciplinary Knowledge: Carry out models to represent the rock cycle. Describe the formation of different materials such as composite or ceramic materials. State the environmental impact of improper waste disposal and overuse of resources without prioritising sustainability. Working Scientifically: Investigate the purity of water by boiling different samples and comparing the boiling temperature to that of the known boiling point of water. Plot scatter graphs from a set of data Use the graphical analysis of your data to interpolate useful values Powerful Knowledge: Sound and Waves SoW: Sound and Waves Substantive Knowledge: Types of Wave, Properties of Waves, Maths in Science - Derived Quantities, Velocity of Waves, Reflection and Refraction, Investigating Waves, Using Waves Disciplinary Knowledge: Use models to represent how longitudinal and transverse waves move through the medium of air. Describe how properties of each wave change as they change medium, or increase / decrease the energy supplied to a wave. Recall the speed of light waves in a vacuum. Working Scientifically: Use perspex blocks and ray boxes to demonstrate reflection and refraction of light rays.	Powerful Knowledge B4: Bioenergetics SoW: Bioenergetics Substantive Knowledge: What is photosynthesis, Limiting factors of photosynthesis, Investigating rate of photosynthesis, Plant uses of glucose, Aerobic respiration, Anaerobic respiration, Body response to exercise, Metabolism *Separate Science: Same as above* Disciplinary Knowledge: Solve simple algebraic equations.Use data to relate limiting factors to the cost effectiveness of adding heat, light or carbon dioxide to greenhouses.Investigations into the effect of exercise on the body *Separate Science: Same as above* Working Scientifically: investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed. *Separate Science: Same as above* Powerful Knowledge:P4 Atomic Structure SoW: Atomic Structure Substantive Knowledge: Atomic structure, Development of atomic structure, Ions and isotopes, Types of decay (alpha beta gamma), Nuclear decay equations, Half life, irradiation and contamination, dangers of using radiation, Uses of radiation. *Separate Science: Same as above with the addition of Half life of radioactive isotopes,, Background radiation, Nuclear fission, Nuclear fusion* Disciplinary Knowledge: Use models in explanations, or match features of a model to the data from experiments or observations that the model describes or explains. Make predictions or calculate quantities based on the model or show its limitations. Give examples of ways in which a model can be tested by observation or experiment. Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments. Describe and explain specified examples of the technological applications of science. Describe and evaluate, with the help of data, methods that can be used to tackle problems caused by human impacts on the environment. *Separate Science: Same as above*	GCSE Prep

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	apparatus or material that should be used for a particular purpose, and explain why.Select the best procedure from given options. Explain why a given practical procedure is well designed for its specified purpose. Identify names and uses of basic lab equipment and apparatus. Apply understanding of apparatus and techniques to suggest a procedure for a specified purpose. Assess risk, to include: Identifying hazard symbols. Describing sensible precautions to reduce risk Working Scientifically: Measure volumes of liquids accurately Measure temperature accurately Safe use of equipment to separate mixtures using: • Evaporation • filtration • crystallisation • chromatography • distillation Plot two variables from experimental or other data. Produce clear, labelled scientific drawings Safe use of heating devices and techniques, including Bunsen burner, electric heater and water bath	Measure pH. Describe representative sampling techniques. Apply representative sampling techniques and explain why it is appropriate. Identify and assess risks to health related to lifestyle habits and the risk of disease. Suggest sensible precautions to reduce risk. Safe use of equipment to separate mixtures using chromatography. Suggest a hypothesis to explain given observations or data. Explain why a certain hypothesis was chosen, with reference to scientific theories and explanations		Working Scientifically: Use use standard notation numbers to represent large and small numbers, as well as solving calculations with them. Use the results from a penetration experiment (beta particles passing through card) could be used in industrial applications of thickness control. Plot scatter graphs from a set of data Use the graphical analysis of your data to interpolate useful values Use the results of a controlled investigation in real-life applications. *Separate Science: Same as above* Powerful Knowledge :C5 Energy Changes SoW: Energy Changes Substantive Knowledge: Exothermic and endothermic reactions, Required prac 1, Required prac 2, Reaction profiles and activation energy, Calculating energy change (higher) *Separate Science: Same as above with the addition of Fuel cells* Disciplinary Knowledge: Measure temperature changes when substances react or dissolve in water. use scientific theories and explanations to develop hypotheses. plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena.apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment. carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations. make and record observations and measurements using a range of apparatus and methods. *Separate Science: Same as above* Working Scientifically: investigate the variables that affect temperature changes in reacting solutions such as, e.g. acid plus metals, acid plus carbonates, neutralisations, displacement of metals. Use of appropriate apparatus to make and record a range of measurements accurately, including mass, temperature, and volume of liquids. Use of appropriate apparatus and techniques for conducting and monitoring chemical reactions. Making and recording of appropriate observations during chemical reactions including changes in temperature. Safe use and careful handling of gases, liquids and solids, including careful mixing of reagents under controlled conditions, using appropriate apparatus to explore chemical changes. *Separate Science: Same as above*	
Summer 6	Powerful Knowledge: Electric Circuits: SoW: Electric Circuits: Substantive Knowledge: Models of Electricity, Current, Series and Parallel Circuits, Circuit Components, Measuring Current, Measuing Voltage Disciplinary Knowledge: Use models to represent data, events, processes, behaviours and other scientific phenomena Select the best procedure from given	Powerful Knowledge: Light SoW: Light Substantive Knowledge: Understanding Light, Reflection, Refractions, Observing Refraction, Lenses, Colour Disciplinary Knowledge: Describe and explain specified examples of the technological applications of science. Calculate angular measurements in degrees Working Scientifically: Draw a line of best fit.	Powerful Knowledge: Home Electricity SoW: Home Electricity Substantive Knowledge: Mains Electricity, Plugs, Power, The Cost of Electricity, Power in Circuits, Power and Energy in Appliances, Energy Resources, The National Grid, Static Electricity Disciplinary Knowledge: Use circuit diagrams to construct circuits including a variety of common circuit elements. Use	Powerful Knowledge: Ecology SoW: Ecology Substantive Knowledge: Ecosystems recap, Adaptations, RPA Measuring Populations, RPA Measuring Populations 2, Levels of Organisation, How are materials recycled,), Impact of environmental change (triple), Biodiversity and Wate Management, Land Use and Deforestation, Global Warming and maintaining biodiversity, , Food Security, farming techniques, *Separate Science: Same as above with the addition of Decay RP, Decomposition RP, fisheries, Biotechnology , Trophic levels and*	

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	options Explain why a given practical procedure is well designed for its specified purpose. Apply understanding of apparatus and techniques to suggest a procedure for a specified purpose. Use of circuit diagrams to construct and check series and parallel circuits including a variety of common circuit elements Working Scientifically: Use of appropriate apparatus to measure current, potential difference (voltage) and resistance, and to explore the characteristics of a variety of circuit elements	Draw ray diagrams to represent reflection and refraction. Making observations of waves in fluids and solids to identify the suitability of apparatus to measure speed, frequency and wavelength. Making observations of the effects of the interaction of electromagnetic waves with matter.	standard international units when representing different quantities, and convert between different units of measure for larger or smaller quantities. Working Scientifically: Recall the safety features of British plugs. Rewire empty plug casings. Use circuit diagrams to set up and check appropriate circuits to investigate how adding different components in circuits affects the current and potential difference of the circuit.	*pyramids of biomass, Transfer of biomass* Disciplinary Knowledge: Recording firsthand observations of organisms. Extract and interpret information from charts, graphs and tables. Interpret graphs used to model predator-prey cycles. Interpret and explain the processes in diagrams of the carbon cycle, the water cycle. Explain how waste, deforestation and global warming have an impact on biodiversity. Understand the conflict between the need for cheap available compost to increase food production and the need to conserve peat bogs and peatlands as habitats for biodiversity and to reduce carbon dioxide emissions. Evaluate the environmental implications of deforestation. *Separate Science: Same as above* Working Scientifically: measure the population size of a common species in a habitat. Use sampling techniques to investigate the effect of a factor on the distribution of this species. : investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change. *Separate Science: Same as above* Powerful Knowledge: Chemical Analysis SoW: Chemical Analysis Substantive Knowledge: Pure substances and Formulations, Chromatography RPA, Interpreting Chromatograms, Gas tests, *Separate Science: Same as above with the addition of Flame tests, Test for positive ions and spectra, Test for negative ions* Disciplinary Knowledge: Recognise and use expressions in decimal form. Make estimates of the results of simple calculations. An opportunity to investigate flame colours. Make precipitates of metal hydroxides. Observe flame spectra using a handheld spectroscope. *Separate Science: Same as above* Working Scientifically: : investigate how paper chromatography can be used to separate and tell the difference between coloured substances. Students should calculate Rf values. use of chemical tests to identify the ions in unknown single ionic compounds covering the ions *Separate Science: Same as above*	