Medium Term Planning – AC1

Curriculum: Science

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Year	Topic Detail and Sequence	Pre-requisite Knowledge	Key Vocabulary	Demonstrable Skills
7	**Particle Model and Particulate Nature of Matter** Particle model and prosperities of solid, liquid and gases 1. Density 2. Diffusion 3. Brownian motion of gas 4. Gas pressure 5. Pressure and volume 6. Conservation of mass **Energy in Matter** 1. Changing state 2. Cooling curves **Atoms, Elements and Compounds** What are atoms, elements and compounds 1. Simple atomic model/sub atomic particles 2. Symbols and molecular formula **Physical Changes** 1. The difference between chemical and physical changes 2. Making solutions and Separation methods	**KS1** Be able to: identify materials objects are made up of Describe the physical properties of objects Group together objects with similar physical properties Link objects properties to their uses Be able to: compare and group materials together, according to whether they are solids, liquids or gases observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C) identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature **KS2** Be able to: compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic demonstrate that dissolving, mixing and changes of state are reversible changes explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda	**Particle:** A very tiny object such as an atom or molecule, too small to be seen with a microscope. **Particle model:** A way to think about how substances behave in terms of small, moving particles. **Diffusion**: The process by which particles in liquids or gases spread out through random movement from a region where there are many particles to one where there are fewer. **Gas pressure:** Caused by collisions of particles with the walls of a container. Density: How much matter there is in a particular volume, or how close the particles are. **Evaporate:** Change from liquid to gas at the surface of a liquid, at any temperature. **Boil:** Change from liquid to a gas of all the liquid when the temperature reaches boiling point. **Condense**: Change of state from gas to liquid when the temperature drops to the boiling point. **Melt**: Change from solid to liquid when the temperature rises to the melting point. **Freeze**: Change from liquid to a solid when the temperature drops to the melting point. **Sublime**: Change from a solid directly into a gas. **Solvent**: A substance, normally a liquid, that dissolves another substance. **Solute**: A substance that can dissolve in a liquid. **Dissolve**: When a solute mixes completely with a solvent. **Solution**: Mixture formed when a solvent dissolves a solute. **Soluble (insoluble):** Property of a substance that will (will not) dissolve in a liquid. **Solubility**: Maximum mass of solute that dissolves in a certain volume of solvent.	**KNOW** Properties of solids, liquids and gases can be described in terms of particles in motion but with differences in the arrangement and movement of these same particles: closely spaced and vibrating (solid), in random motion but in contact (liquid), or in random motion and widely spaced (gas). Observations where substances change temperature or state can be described in terms of particles gaining or losing energy A pure substance consists of only one type of element or compound and has a fixed melting and boiling point. Mixtures may be separated due to differences in their physical properties. The method chosen to separate a mixture depends on which physical properties of the individual substances are different. Most substances are not pure elements, but compounds or mixtures containing atoms of different elements. They have different properties to the elements they contain.

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7			**Pure substance:** Single type of material with nothing mixed in. **Mixture**: Two or more pure substances mixed together, whose properties are different to the individual substances. **Filtration**: Separating substances using a filter to produce a filtrate (solution) and residue. **Distillation**: Separating substances by boiling and condensing liquids. **Evaporation**: A way to separate a solid dissolved in a liquid by the liquid turning into a gas. **Chromatography**: Used to separate different coloured substances. **Elements**: What all substances are made up of, and which contain only one type of atom. **Atom**: The smallest particle of an element that can exist. **Molecules**: Two to or more atoms chemically joined together. Most non-metals exist either as small or giant molecules. **Compound**: Pure substances made up of two or more elements chemically joined together. **Chemical formula**: Shows the elements present in a compound and their relative proportions. **Physical change:** A reversible change in the physical properties of a substance, as size or shape. Freezing a liquid is a physical change. **Chemical reaction:** a process in which one or more substances, the reactants, are converted to one or more different substances, the products. **Density**: mass per unit volume or the degree of compactness of a substance **Volume**: the amount of space that a substance or object occupies, or that is enclosed within a container.	**APPLY** Explain observations about gas pressure in terms of particles. Explain the properties of solids, liquids and gases based on the arrangement and movement of their particles. Explain changes in states in terms of changes to the energy of particles. Draw before and after diagrams of particles to explain observations about changes of state and gas pressure Using particle models, explain why diffusion only happens in liquids and gasses. Explain how substances dissolve using the particle model. Use the solubility curve of a solute to explain observations about solutions. Use evidence from chromatography to identify unknown substances in mixtures. Choose the most suitable technique to separate out a mixture of substances. Name compounds using their chemical formulae. Given chemical formulae, name the elements present and their relative proportions. Represent atoms, molecules and elements, mixtures and compounds using particle diagrams. **UNDERSTAND** Classify substances which behave unusually as solids, liquids or gases. Evaluate cooling curves to determine the melting/boiling point of an unknown substance Provide evidence for the existence of particles. Predict what will happen during unfamiliar physical processes, in terms of particles and their energy. Use particle diagrams to predict physical properties of elements and compounds. Understand how pressure and volume are connected to gas pressure

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8	Forces: 1. What is a force? 2. Types / examples of forces 3. Measuring forces 4. Frictional forces / streamlining 5. Gravity (Weight vs mass, W=mg) Balanced Forces: 6. Force diagrams 7. Balanced forces & Newton's 1st law 8. Unbalanced forces cause a change in motion 9. Resultant forces and Newton's 2nd Law Forces & motion: 10. Speed (calculation / average / instantaneous) 11. Relative motion 12. Acceleration / deceleration Describing motion 13. Distance / time graphs 14. Speed / time graphs Turning forces: 15. Moments 16. Simple machines 17. Deformation (compression & extension) 18. Hooke's Law	Expected from KS2: Basic contact forces. Forces can act over a distance. Gravity – pulls objects towards Earth Effects of air resistance, water resistance & friction Levers / pulleys / gears (force magnifiers). Friction investigations.	**Force:** Forces are pushes or pulls. They can be balanced or unbalanced. If unbalanced they can change the shape of objects and change the way they are moving. **Balanced:** Balanced forces are two forces acting in opposite directions on an object, and equal in size. They do not cause a change in motion. **Unbalanced:** Forces that cause a change in the motion of an object are unbalanced forces. Unbalanced forces are not equal and opposite. **Resultant:** The overall (net) effect of two or more forces on an object **Stationary:** Not moving **Constant:** A quantity that does not change **Moment:** The turning effect of a force around a pivot (the turning point).	• Identify a range of forces. • Draw force diagrams for familiar and unfamiliar situations • Recall Newton's 1st & 2nd laws of motion. • Recognise when forces are balanced / unbalanced. • Calculate the resultant force from a force diagram. • Describe the change in motion caused by an unbalanced force. • Calculate the average speed for a journey. • Explain why the average speed for a journey may be different to speed at a point during the journey. • Explain, and give examples of relative motion. • Use motion graphs to describe a journey. • Use motion graphs to calculate speed and acceleration. • Identify situations where turning forces exist. • Calculate the turning effect of a force • Explain how simple machines work • Describe the relationship between force applied and extension for a spring • Recall Hooke's law. • Describe what happens once the elastic limit is exceeded

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9	**Energy Changes and Transfers in Systems** 1. Energy stores and systems 2. Changes in energy 3. Energy changes in systems 4. Power 5. Energy transfers in a system 6. Efficiency 7. National and global energy resources **Calculation of fuel uses and costs in the domestic context** 1. Electrical power 2. Energy transfers in everyday appliances 3. The National Grid 4. Static charge (Physics only) 5. Electric fields (Physics only) **Energy changes (Chem)** 1. Energy transfer during exothermic and endothermic reactions 2. Reaction profiles 3. The energy change of reactions (HT only) 4. Chemical cells and fuel cells (chemistry only) **Bioenergetics** 1. Photosynthesis 2. Aerobic and anaerobic respiration 3. Response to exercise 4. Metabolism	**Energy** • associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit • compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches • use recognised symbols when representing a simple circuit in a diagram **Energy Changes in Chemical Reactions** • Understand the structure of the atom • define chemical reactions as the rearrangement of atoms • representing chemical reactions using formulae and using equations • combustion, thermal decomposition, oxidation and displacement reactions • defining acids and alkalis in terms of neutralisation reactions • the pH scale for measuring acidity/alkalinity; and indicators • reactions of acids with metals to produce a salt plus hydrogen • reactions of acids with alkalis to produce a salt plus water • what catalysts do **Bioenergetics** • energy changes on changes of state (qualitative) • exothermic and endothermic chemical reactions (qualitative) • Give the reactants in, and products of, photosynthesis, and a word summary for photosynthesis • Understand the dependence of almost all life on Earth on the ability of photosynthetic organisms, such as plants and algae, to use sunlight in photosynthesis to build organic molecules that are an essential energy store and to maintain levels of oxygen and carbon dioxide in the atmosphere • Explain the adaptations of leaves for photosynthesis • aerobic and anaerobic respiration in living organisms, including the breakdown of organic molecules to enable all the other chemical processes necessary for life • a word summary for aerobic respiration • the process of anaerobic respiration in humans and micro-organisms, including fermentation, and a word summary for anaerobic respiration • the differences between aerobic and anaerobic respiration in terms of the reactants, the products formed and the implications for the organism	**energy** The capacity for doing work. **energy store** The different ways in which energy can be stored, including chemical, kinetic, gravitational potential, elastic potential and thermal stores. **internal energy** The total kinetic energy and potential energy of the particles in an object. **transfer** When something is moved from one place to another. This may be people, objects or energy. **efficiency** The fraction of the energy supplied to a device which is transferred in a useful form. **rate** Per unit time or 'per second'. For example, if 2,000 J are transferred over a period of 10 s, then the rate of transfer is 200 J/s or 200 W. This value is the power rating. **specific heat capacity** The amount of energy needed to raise the temperature of 1 kg of substance by 1°C. **molecule** A collection of two or more atoms held together by chemical bonds. **renewable** Energy sources that are replenished and not exhausted, eg solar power. **finite** Something that has a limited number of uses before it is depleted. For example, oil is a finite resource. **activation energy** The minimum amount of energy that colliding particles must have for them to react. **exothermic** Reaction in which energy is given out to the surroundings. The surroundings then have more energy than they started with so the temperature increases. **product** A substance formed in a chemical reaction. **reactant** A substance that reacts together with another substance to form products during a chemical reaction. **carbohydrate** Food belonging to the food group consisting of sugars, starch and cellulose. Carbohydrates are vital for energy in humans and are stored as fat if eaten in excess. In plants, carbohydrates are important for photosynthesis. **enzyme** A protein which catalyses or speeds up a chemical reaction. **metabolism** All the chemical reactions in the cells of an organism, including respiration. **aerobic respiration** Respiration that requires oxygen.	• Name the 9 stores of energy and describe their characteristics. • Describe energy changes between these stores. • Calculate the KE, GPE and EPE • Calculate the energy stored or released by an object changing temperature. (SHC and LH • Define and calculate power • Understand the idea of conservation of energy. • Calculate efficiency of energy transfers with both energies and power. • Describe how to increase efficiency of transfers. • describe the main energy sources available • distinguish renewable and non-renewable • compare ways that different energy resources are used, the • understand why some energy resources are more reliable • describe the environmental impact arising from the use of different energy resources • consider the environmental issues Science and political, social, ethical or economic considerations • distinguish between exothermic and endothermic reactions on the basis of the temperature change of the surroundings • evaluate uses and applications of exothermic and endothermic reactions • Draw reaction profiles • Identify whether profiles represent exo or endothermic reactions • Explain the idea of activation energy • Calculate the energy transferred by chemical reactions using bond energies. • Describe the function of cells and batteries • Interpret data for reactivity of different metals • Evaluate the use of batteries and fuel cells • Write half equations for hydrogen fuel cell.

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10	**Atomic Structure** 1. The structure of an atom. 2. Mass number, atomic number 3. Isotopes 4. The development of the model of the atom 5. Radioactive decay 6. Nuclear Radiation 7. Nuclear Equations 8. Random Nature of decay 9. Half Life 10. Radioactive Contamination 11. Hazards of radiation (Separate Only) 12. Background radiation (Separate Only) 13. Nuclear Fission 14. Nuclear Fusion	**Atomic Structure** • A simple (Dalton) atomic model • Differences between atoms, elements and compounds • Chemical symbols and formulae for elements and compounds • Conservation of mass changes of state and chemical reactions • Recognition of standard form • Understanding of the layout of the periodic table • Calculation of percentages	**Atom:** the smallest particle of a chemical element that can exist. The word is derived from the Greek word "atomos", meaning indivisible. An atom consists of a nucleus containing protons and neutrons, surrounded by electrons. **Compound:** Two or more elements chemically joined together. "to put together, to mix, to combine; to join, couple together," from Old French compondre Compounds have different properties to the elements that make hem up **Electron:** Subatomic particle, with a charge of -1, a mass of almost 0. The Greek word for “amber” is “electron” Electricity is the movement of electrical charge through a circuit (usually, flowing electrons.) **Element:** A substance made of one type of atom only. Middle English (denoting fundamental constituents of the world or celestial objects): via Old French from Latin elementum ‘principle, rudiment’, translating Greek stoikheion ‘step, component part’. There are about 100 different elements. **Isotope:** Atoms of an element with the same number of protons and electrons but different numbers of neutrons. 1913: coined by F. Soddy, from iso- ‘equal’ + Greek topos ‘place’ (because the isotopes occupy the same place in the periodic table of elements). They have the same chemical properties as they have the same number of electrons **Neutron:** Uncharged subatomic particle, with a mass of 1 relative to a proton. The relative charge of a neutron is 0. electrically neutal particle of the atom," 1921, coined by U.S. chemist William D. **Nucleus:** The central part of an atom. It contains protons and neutrons, and has most of the mass of the atom. The plural of nucleus is nuclei. early 18th century: from Latin, literally ‘kernel, inner part’, diminutive of nux, nuc- ‘nut’.	• Describe in detail the structure of the atom including the properties of its constituents. • Use the AXZ notation to identify the make up of particular elements. • Describe how the model of the atom evolved referring to evidence and differences between the models. • Describe the random nature of decay and explain how its measured. • Explain the properties of the different ionising radiations. • Represent the different types of radiations using nuclear equations. • Explain the effect of the atom of the emission of different types of radiations • Understand and give examples of irradiation and contamination. • Give uses and dangers of radiations. • Understand the processes of nuclear fission and fusion.

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10	**Cell Processes** 1. Eukaryotes and prokaryotes 2. Animal and plant cells 3. Cell specialisation 4. Cell differentiation 5. Microscopy 6. Culturing microorganisms (biology only) 7. Chromosomes 8. Mitosis and the cell cycle 9. Stem cells 10. Diffusion 11. Osmosis 12. Active transport **Energy Changes and Transfers in Systems** 1. Energy stores and systems 2. Changes in energy 3. Energy changes in systems 4. Power 5. Energy transfers in a system 6. Efficiency 7. National and global energy resources	**Cell Processes** • cells as the fundamental unit of living organisms, including how to observe, interpret • and record cell structure using a light microscope • he functions of the cell wall, cell membrane, cytoplasm, nucleus, vacuole, • mitochondria and chloroplasts • the similarities and differences between plant and animal cells • the role of diffusion in the movement of materials in and between cells • the structural adaptations of some unicellular organisms • the hierarchical organisation of multicellular organisms: from cells to tissues to organs • to systems to organisms.	**Eukaryotic:** Cell with a nucleus, characterized by well-defined cells (with nuclei and cell walls)," 1957, from French eucaryote (1925), from Greek eu "well, good" (see eu-) + karyon "nut, kernel“ **Prokaryotic:** Cell without a nucleus. The word prokaryote comes from the Greek πρό (pro, 'before') and κάρυον (karyon, 'nut' or 'kernel'). Prokaryotes are divided into two domains, Archaea and Bacteria. **Sub-cellular structures:** Small structures inside a cell e.g. nucleus, sub- under, beneath, cellular – to do with cells. **Nucleus:** Contains DNA, early 18th century: from Latin, literally ‘kernel, inner part’, diminutive of nux, nuc- ‘nut’. **Cytoplasm:** Where chemical reactions take place, organic substance forming the essential constituent of cells," 1870, from cyto- "cell" + -plasm. Related: Cytoplasmic. **Cell membrane:** Controls what enters and leaves the cell. A membrane is a thin layer of skin or soft tissue of the body," a term in anatomy, from Latin membrana "a skin, membrane; parchment (skin prepared for writing)," from membrum "limb, member of the body" (see member). The etymological sense is "that which covers the members of the body." **Mitochondria:** Where aerobic respiration takes place, early 20th century: modern Latin, from Greek mitos ‘thread’ + khondrion (diminutive of khondros ‘granule’). **Ribosomes:** Where protein synthesis occurs,1958, coined by U.S. microbiologist Richard B. Roberts (1910-1980) from ribo(nucleic acid) + -some "body." **Chloroplasts:** Where photosynthesis occurs The word chloroplast is derived from the Greek words chloros (χλωρός), which means green, and plastes (πλάστης), which means "the one who forms" **Vacuole:** Contains cell sap, keeps the cell turgid. id 19th century: from French, diminutive of Latin vacuus ‘empty’ **Differentiation:** When a cell becomes a specialised cell, early 19th century: from medieval Latin differentiat- ‘carried away from’, from the verb differentiare, from differentia **Diffusion:** The movement of particles from a HIGH concentration to a LOW concentration down a concentration gradient late Middle English (in the sense ‘pouring out, effusion’): from Latin diffusio(n-), from diffundere ‘pour out’. **Osmosis:** The movement of WATER from a DILUTE solution to a MORE CONCENTRATED solution, mid 19th century: Latinized form of earlier osmose, from Greek ōsmos ‘a push’. **Active transport:** The movement of particles, e.g. mineral ions, from a HIGH concentration to a LOW concentration, AGAINST the concentration gradient, using ENERGY. Active - Middle English (in the sense ‘preferring action to contemplation’): from Latin *activus*, from *act-* ‘done’, from the verb *agere* .Transport Middle English: from Old French *transporter* or Latin *transportare*, from *trans-* ‘across’ + *portare* ‘carry’. Active transport is a good example of a process for which cells require energy.	• Identify cell structures and describe their functions • Categorise cells of different types • Understand the process of cell differentiation to form specialised cells • Explain how to use the different types of microscopes • Describe how to culture bacteria • Understand how cells replicate • Understand the movement of substances into and out of cells.

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11	Forces & Motion 1. Scalar and vector quantities 2. Contact and non-contact forces 3. Gravity 4. Resultant forces 5. Work done and energy transfer 6. Forces and elasticity 7. Moments, levers and gears (physics only) 8. Pressure and pressure differences in fluids (physics only) 9. Atmospheric pressure 10. Distance and displacement 11. Speed 12. Velocity 13. The distance–time relationship 14. Forces, accelerations and Newton's Laws of motion 15. Forces and braking 16. Momentum (HT only) Organic Chemistry 1. Crude oil, hydrocarbons and alkanes 2. Cracking and alkenes 3. Reactions of alkenes and alcohols (chemistry only) 4. Synthetic and naturally occurring polymers (chemistry only) **Organisation** 1. Enzymes 2. The heart & blood vessels 3. Blood 4. Coronary heart disease: a non-communicable disease 5. Health issues 6. The effect of lifestyle on some non-communicable diseases 7. Cancer 8. Plant tissues, organs and systems	Forces and Motion Identify a range of forces. Draw force diagrams for familiar and unfamiliar situations Recall Newton's 1st & 2nd laws of motion. Recognise when forces are balanced / unbalanced. Calculate the resultant force from a force diagram. Describe the change in motion caused by an unbalanced force. Calculate the average speed for a journey. Explain why the average speed for a journey may be different to speed at a point during the journey. Explain, and give examples of relative motion. Use motion graphs to describe a journey. Use motion graphs to calculate speed and acceleration. Identify situations where turning forces exist. Calculate the turning effect of a force Explain how simple machines work Describe the relationship between force applied and extension for a spring Recall Hooke's law. Describe what happens once the elastic limit is exceeded Organic Chemistry Compounds elements and mixtures Chemical Reactions Word Equations Balanced Symbol Equations Displacement Reactions **Organ** **Tissue** **Cell** **System**	**magnitude** The size of a physical quantity. **resultant force** The single force that could replace all the forces acting on an object, found by adding these together. If all the forces are balanced, the resultant force is zero. **mass** The amount of matter an object contains. Mass is measured in kilograms (kg) or grams (g). **Attract** Objects that tend to move together because of a force between them attract each other. **repel** Objects that tend to push apart because of a force between them repel each other. **weight** The force acting on an object due to the pull of gravity from a massive object like a planet. The force acts towards the centre of the planet and is measured in newtons (N). **work done** The amount of energy it takes to do a task. Measured in joules (J). For example, the work done in raising a mass through 10 m would be equal to the gain in potential energy of the mass. **elastic** Elastic materials return to their original shape and size after being stretched or squashed. **deformation** Changing shape and/or size as a result of forces being applied. **moment** A turning effect of a force. **pivot** A point around which something can rotate or turn. **momentum** A quantity relating to a moving object that is calculated by multiplying its mass by its velocity. **rate of change** The amount of change in the size of a quantity each second. **alkane** Saturated hydrocarbon. A compound of hydrogen and carbon only, with no C=C bonds. **alkene** Unsaturated hydrocarbon with a double bond between the carbon atoms. **functional group** An atom, or group of atoms, that determines the main chemical properties of an organic compound. **Ester** A type of organic compound formed in the reaction between an alcohol and a carboxylic acid. **homologous series** A 'family' of organic compounds that have the same functional group and similar chemical properties. **alcohol** An organic compound containing a hydroxyl group, -OH. The 'alcohol' in alcoholic drinks is ethanol, produced by the fermentation of sugars and found in wines, spirits and beers.	Define scalars and vectors giving examples of each. Define non-contact and contact forces, giving examples of each. Understand gravity both qualitatively and quantitatively Understand how to determine the resultant force on a object and describe the effects. Define and calculate work done Describe and explain how forces change the shape of objects. **Explain how turning effect and other methods of mechanical advantage** **Understand pressure in fluids** Understand the concepts of speed and velocity quantitatively and qualitatively Analyse graphs of motion Understand the relationship between forces and motion Recall and apply Newton's laws in a range of contexts. Understand how braking works and the factors that affect it. **Define momentum, use calculations and conservation of momentum to solve explosion and collision problems.** Define the terms crude oil, hydrocarbons, alkanes and alkenes. Explain the process of fractional distillation, giving names and uses of the fractions in order of boiling point. Define the term cracking and give the conditions of the reaction under which it occurs. State why it is necessary. Describe the test and positive results for the test for alkenes. **Define the alcohols group, naming the first four. Describe how they are made and evaluate the impact of the manufacture.** **Define esters and carboxylic acids describing how they are made.** **Describe emulsions and hydrogenation**