Science Topics – Atomic Structure

In year 11 we teach the following modules over the course of the year. Each module draws on prior learning from **KS2** and builds on understanding from the **KS2** programme of study. Each module develops and deepens the Core knowledge that will underpin all areas of the curriculum at **KS3** and **KS4**.

Topic	Rationale	Knowledge acquisition	Key vocabulary	Skills and enrichment e.g independence, problem solving, evaluation, analysis, creativity, literacy, numeracy and oracy
Atomic Structure	Ionising radiation is hazardous but can be very useful. Although Radioactivity was discovered over a century ago, it took many nuclear physicists several decades to understand the structure of the atom, nuclear forces and stability. Early researchers suffered from their exposure to the radiation. Rules for radiological protection were first introduced in the 1930s and subsequently improved.	Atoms and isotopes – the structure of an atom	Nucleus, protons, neutrons, electrons, electromagnetic radiation, energy levels	Numeracy Recognise and use expressions in standard form. Use ratios, fractions and percentages. Substitute numerical values into algebraic equations using appropriate units for physical quantities. Solve algebraic equations. Translate information between graphical and numeric form. Literacy Understand scientific methods and theories and how they develop over time. Use a variety of models to make predictions and develop scientific explanations and understanding.
		Mass number, atomic number and isotopes.	Electrical charge, elements, mass number, atomic number, isotopes,	
		The development of the model of the atom (common content with chemistry)	Scientific model, alpha, beta, gamma, nuclear model,	
		Radioactive decay and nuclear radiation	Radiation, radioactive decay, Becquerel, count rate, Geiger-Muller tube, decays,	
		Nuclear equations to represent radioactive decay.	Balanced equations, atomic numbers, mass numbers. Emission, daughter elements,	
		Half-lives and the random nature of radioactive decay.	Radioactive isotopes, count rate, half-life	
		Radioactive contamination	Contamination, hazard, irradiation, contamination, precautions,	
		Background radiation	Back ground radiation, cosmic rays, sieverts	
		Different half-lives of radioactive isotopes		
		Uses of nuclear radiation	Evaluation of perceived risks in relation to data and handling.	
		Nuclear fission and fusion	Uranium, plutonium, fission, fusion, kinetic energy, chain reaction, nuclear reactor.	

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Energy	The concept of energy emerged in the 19th Century. The idea was used to explain the work output of steam engines and then generalised to understand other heat engines. It is a key tool for understanding chemical reactions and biological systems.	Energy stores and systems,	Energy, work, energy stores, system,	Numeracy Calculations of energy changes. Inter convert units. Use SI units. Use appropriate number of significant figures. Use algebraic equations / substitute and rearrange equations. Literacy Use of models to solve problems, make predictions and develop scientific explanations and understanding of familiar and unfamiliar facts. Links between work done and current flow in a circuit.
		Changes in energy- energy associated with moving objects, stretched springs and objects raised above the ground.	Energy transfers, Kinetic energy, speed, velocity, limit of proportionality, gravitational potential energy, field strength, Joules, Newtons,	
		Energy changes in systems – energy stored and released.	Specific heat capacity, thermal energy, degree Celsius,	
		Power- the rate at which energy is transferred or the rate at which work is done.	Power, work done, watts,	
		Conservation and dissipation of energy	Thermal conductivity, insulation, dissipated, closed system, net change, lubrication, conduction, convection.	
		Efficiency	Energy efficiency, output, input,	
		National and global energy resources	Fossil fuels, nuclear fuel, biofuel, wind turbines, hydro-electricity, geothermal, tidal power, renewable resources, environmental impact.	

Topic	Rationale	Knowledge acquisition	Key vocabulary	Skills and enrichment e.g independence,
4.3 Particle Model of Matter	The particle model is widely used to predict the behaviour of solids, liquids and gases and this has many applications in everyday life. It helps us to explain a wide range of observations and engineers use these principles when designing vessels to withstand high pressures and temperatures, such as submarines and spacecraft. It also explains why it is difficult to make a good cup of tea high up a mountain!	What is the particle model of matter?	Solids, liquids, gases, particles, arrangement, forces of attraction, density	Practical skills: Use apparatus to make and record the measurements needed to determine the density of regular and irregular shaped objects **REQUIRED PRACTICAL – DENSITY** Evaluation: critically evaluate the models used to describe the behaviour of solids, liquids and gases Creativity: model evaporation using ping pong balls in a tray Practical skills: finding the melting point of salol – compare with true values and discuss any discrepancies Practical skills – investigate the heating curve of water by melting ice. Record the temperature every 30seconds and plot a temperature against time graph Independence – research how the gas pressure in a submarine stops it from being crushed at depth Independence – research what a barometer measures and how it works Practical skills – collect steam in a balloon to inflate and deflate in ice water
		What is density? How is it calculated?	Density, mass, volume, formula	
		How do we determine density from experiment?	Density, displacement can, volume, mass, regular, irregular,	
		What are changes of state?	State, melt, evaporate, condense, freeze, sublimate	
		What is the difference between heat and temperature?	Heat, temperature, energy, thermometer, scale, Celsius	
		What is the internal energy of a system?	Internal energy, kinetic energy, potential energy, particles, change of state	
		What is specific heat capacity? How is it calculated?	Mass, material, energy, specific heat capacity, thermal energy, joules	
		How can we use experiments to determine specific heat capacity?	Independent, dependent, control, variables	
		What is specific latent heat? How is it calculated? How can it be represented graphically?	Latent, heat, internal energy, mass, joules, kilograms, fusion, vaporisation, vapour	
		How do the particles in a gas move?	Random, motion, direction, speeds	

		What is gas pressure? What affect does changing temperature have on gas pressure?	Pressure, temperature, molecules	
		How are gas pressure and volume related?	Pressure, volume, constant	