**Science – Overview of KS3 Curriculum Topics - YEAR 9**

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| **AUTUMN 1** | CHEMISTRY TOPIC 1 - ATOMIC STRUCTURE & THE PERIODIC TABLE | 5.1.1 A simple model of the atom, symbols, relative atomic mass, electronic charge and isotopes |  State that everything is made of atoms and recall what they are |
|  Describe what elements and compounds are |
|  State that elements and compounds are represented by symbols; and use chemical symbols and formulae to represent elements and compounds |
|  Write word equations and balanced symbol equations for chemical reactions, including using appropriate state symbols |
|  HT ONLY: Write balanced half equations and ionic equations |
|  Describe what a mixture is |
|  Name and describe the physical processes used to separate mixtures and suggest suitable separation techniques |
|  Describe how the atomic model has changed over time due to new experimental evidence, inc discovery of the atom and scattering experiments (inc the work of James Chadwick) |
|  Describe the difference between the plum pudding model of the atom and the nuclear model of the atom |
|  State the relative charge of protons, neutrons and electrons and describe the overall charge of an atom |
|  State the relative masses of protons, neutrons and electrons and describe the distribution of mass in an atom |
|  Calculate the number of protons, neutrons and electrons in an atom when given its atomic number and mass number |
|  Describe isotopes as atoms of the same element with different numbers of neutrons |
|  Define the term relative atomic mass and why it takes into account the abundance of isotopes of the element |
|  Calculate the relative atomic mass of an element given the percentage abundance of its isotopes |
|  Describe how electrons fill energy levels in atoms, and represent the electron structure of elements using diagrams and numbers |
| 5.1.2 The periodic table  |  Recall how the elements in the periodic table are arranged  |
|  Describe how elements with similar properties are placed in the periodic table |
|  Explain why elements in the same group have similar properties and how to use the periodic table to predict the reactivity of elements |
|  Describe the early attempts to classify elements  |
|  Explain the creation and attributes of Mendeleev's periodic table |
|  Identify metals and non-metals on the periodic table, compare and contrast their properties  |
|  Explain how the atomic structure of metals and non-metals relates to their position in the periodic table |
|  Describe noble gases (group 0) and explain their lack of reactivity |
|  Describe the properties of noble gases, including boiling points, predict trends down the group and describe how their properties depend on the outer shell of electrons |
|  Describe the reactivity and properties of group 1 alkali metals with reference to their electron arrangement and predict their reactions |
|  Describe the properties of group 7 halogens and how their properties relate to their electron arrangement, including trends in molecular mass, melting and boiling points and reactivity |
|  Describe the reactions of group 7 halogens with metals and non-metals |

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| **AUTUMN 1** | BIOLOGY TOPIC 1 - CELL BIOLOGY |  4.1.1 Cell structure  | Use the terms 'eukaryotic' and 'prokaryotic' to describe types of cells |
| Describe the features of bacterial (prokaryotic) cells |
| Demonstrate an understanding of the scale and size of cells and be able to make order of magnitude calculations, inc standard form |
| Recall the structures found in animal and plant (eukaryotic) cells inc algal cells |
| Use estimations and explain when they should be used to judge the relative size or area of sub-cellular structures |
| *Required practical 1: use a light microscope to observe, draw and label a selection of plant and animal cells* |
| Describe the functions of the structures in animal and plant (eukaryotic) cells |
| Describe what a specialised cell is, including examples for plants and animals |
| Describe what differentiation is, including differences between animals and plants |
| Define the terms magnification and resolution |
| Compare electron and light microscopes in terms of their magnification and resolution |
| Carry out calculations involving magnification using the formula: magnification = size of image/ size of real object -inc standard form |
| **AUTUMN 2** | BIOLOGY TOPIC 1 - CELL BIOLOGY |  4.1.2 Cell division | Describe how genetic information is stored in the nucleus of a cell (inc genes & chromosomes) |
| Describe the processes that happen during the cell cycle, including mitosis (inc regcognise and describe where mitosis occurs) |
| Describe stem cells, including sources of stem cells in plants and animals and their roles |
| Describe the use of stem cells in the production of plant clones and therapeutic cloning |
| Discuss the potential risks, benefits and issues with using stem cells in medical research/treatments (inc diabetes and paralysis) |
| 4.1.3 Transport in cells | Describe the process of diffusion, including examples |
| Explain how diffusion is affected by different factors |
| Define and explain "surface area to volume ratio", and how this relates to single-celled and multicellular organisms (inc calculations) |
| Explain how the effectiveness of an exchange surface can be increased, inc examples of adaptations for small intestines, lungs, gills roots & leaves |
| Describe the process of osmosis (inc calculation of water uptake & percentage gain and loss of mass of plant tissue) |
| *Required practical 3: investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue* |
| Describe the process of active transport, including examples - gut and roots |
| Explain the differences between diffusion, osmosis and active transport |

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| **AUTUMN 2** | PHYSICS TOPIC 1 - ENERGY | 6.1.1 Energy changes in a system, and the ways energy is stored before and after such changes |  Define a system as an object or group of objects and state examples of changes in the way energy is stored in a system |
|  Describe how all the energy changes involved in an energy transfer and calculate relative changes in energy when the heat, work done or flow of charge in a system changes |
|  Use calculations to show on a common scale how energy in a system is redistributed |
|  Calculate the kinetic energy of an object by recalling and applying the equation: *[ Ek = ½mv2 ]* |
|  Calculate the amount of elastic potential energy stored in a stretched spring by applying, but not recalling, the equation: *[ Ee= ½ke2 ]* |
|  Calculate the amount of gravitational potential energy gained by an object raised above ground level by recalling and applying, the equation: *[ Ee = mgh ]* |
|  Calculate the amount of energy stored in or released from a system as its temperature changes by applying, but not recalling, the equation: *[ ΔE = mcΔ*θ *]* |
|  Define the term 'specific heat capacity' |
|  *Required practical 14: investigation to determine the specific heat capacity of one or more materials.*  |
|  Define power as the rate at which energy is transferred or the rate at which work is done and the watt as an energy transfer of 1 joule per second |
|  Calculate power by recalling and applying the *equations: [ P = E/t & P = W/t ]* |
|  Explain, using examples, how two systems transferring the same amount of energy can differ in power output due to the time taken |
| 6.1.2 Conservation and dissipation of energy |  State that energy can be transferred usefully, stored or dissipated, but cannot be created or destroyed and so the total energy in a system does not change |
|  Explain that only some of the energy in a system is usefully transferred, with the rest ‘wasted’, giving examples of how this wasted energy can be reduced |
|  Explain ways of reducing unwanted energy transfers and the relationship between thermal conductivity and energy transferred |
|  Describe how the rate of cooling of a building is affected by the thickness and thermal conductivity of its walls |
|  Calculate efficiency by recalling and applying the equation: *[ efficiency = useful power output / total power input ]* |
|  HT ONLY: Suggest and explain ways to increase the efficiency of an intended energy transfer |
| 6.1.3 National and global energy resources |  List the main renewable and non-renewable energy resources and define what a renewable energy resource is |
|  Compare ways that different energy resources are used, including uses in transport, electricity generation and heating |
|  Explain why some energy resources are more reliable than others, explaining patterns and trends in their use |
|  Evaluate the use of different energy resources, taking into account any ethical and environmental issues which may arise |
|  Justify the use of energy resources, with reference to both environmental issues and the limitations imposed by political, social, ethical or economic considerations |

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| **SPRING 1** | CHEMISTRY TOPIC 2 - BONDING, STRUCTURE & THE PROPERTIES OF MATTER | 5.2.1 Chemical bonds, ionic, covalent and metallic  |  Describe the three main types of bonds: ionic bonds, covalent bonds and metallic bonds in terms of electrostatic forces and the transfer or sharing of electrons |
|  Describe how the ions produced by elements in some groups have the electronic structure of a noble gas and explain how the charge of an ion relates to its group number |
|  Describe the structure of ionic compounds, including the electrostatic forces of attraction, and represent ionic compounds using dot and cross diagrams |
|  Describe the limitations of using dot and cross, ball and stick, two and three-dimensional diagrams to represent a giant ionic structure |
|  Work out the empirical formula of an ionic compound from a given model or diagram that shows the ions in the structure |
|  Describe covalent bonds and identify different types of covalently bonded substances, such as small molecules, large molecules and substances with giant covalent structures |
|  Represent covalent bonds between small molecules, repeating units of polymers and parts of giant covalent structures using diagrams |
|  Draw dot and cross diagrams for the molecules of hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, water, ammonia and methane |
|  Deduce the molecular formula of a substance from a given model or diagram in these forms showing the atoms and bonds in the molecule |
|  Describe the arrangement of atoms and electrons in metallic bonds and draw diagrams the bonding in metals |
| 5.2.2 How bonding and structure are related to the properties of substances  |  Name the three States of matter, identify them from a simple model and state which changes of state happen at melting and boiling points |
|  Explain changes of state using particle theory and describe factors that affect the melting and boiling point of a substance |
|  HT ONLY: Discuss the limitations of particle theory  |
|  Recall what (s), (l), (g) and (aq) mean when used in chemical equations and be able to use them appropriately  |
|  Explain how the structure of ionic compounds affects their properties, including melting and boiling points and conduction of electricity (sodium chloride structure only) |
|  Explain how the structure of small molecules affects their properties |
|  Explain how the structure of polymers affects their properties |
|  Explain how the structure of giant covalent structures affects their properties |
|  Explain how the structure of metals and alloys affects their properties, including explaining why they are good conductors |
|  Explain why alloys are harder than pure metals in terms of the layers of atoms  |
|  Explain the properties of graphite, diamond and graphene in terms of their structure and bonding |
|  Describe the structure of fullerenes, and their uses, including Buckminsterfullerene and carbon nanotubes |
| **SPRING 2** | BIOLOGY TOPIC 2 - ORGANISATION | 4.2.1 Principles of organisation & 4.2.2 Animal tissues, organs and organ systems | Describe the levels of organisation within living organisms  |
| Describe the digestive system and how it works as an organ system (from KS3) |
| Describe basic features of enzymes (inc rate calculations for chemical reactions) |
| Describe the lock and key theory as a model of enzyme action and explain how the shape a of the active sites makes the enzyme specific |
| Explain the effect of temperature and pH on enzymes |
| Describe the digestive enzymes, including their names, sites of production and actions |
| Describe how the products of digestion are used |
| Describe the features and functions of bile and state where it is produced and released from |
| *Required practical 3: use qualitative reagents to test for a range of carbohydrates, lipids and proteins* |
| *Required practical 4: investigate the effect of pH on the rate of reaction of amylase enzyme* |
| Describe the structure of the human heart and lungs (inc how lungs are adapted for gaseous exchange) |
| Explain how the heart moves blood around the body (inc role and position of the aorta, vena cava, pulmonary artery & vein and coronary arteries) |
| Explain how the natural resting heart rate is controlled and how irregularities can be corrected |
| Describe the structure and function of arteries, veins and capillaries |
| Use simple compound measures such as rate and carry out rate calculations for blood flow |
| Describe blood and identify its different components, inc identifying blood cells from photographs/diagrams |
| Describe the functions of blood components, including adaptations to function |
| Describe what happens in coronary heart disease and what statins are used for  |
| Describe and evaluate treatments for coronary heart disease and heart failure (inc drugs, mechanical devices or transplant) |
| Recall that heart valves can become faulty and describe the consequences of this |
| Describe how patients can be treated in the case of heart failure  |
| Describe health and the explain causes of ill-health and the relationship between health and disease |
| Describe how different types of diseases may interact and translate disease incidence information between graphical and numerical forms |
| Describe what risk factors are and give examples discussing human and financial costs of non-communicable diseases at local, national and global levels |
| Describe what cancer is and explain the difference between benign and malignant tumours  |
| Describe the known risk factors for cancer, including genetic and lifestyle risk factors |

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| **SPRING 2** | BIOLOGY TOPIC 2 - ORGANISATION | 4.2.3 Plant tissues, organs and system | Describe plant tissues (epidermal, palisade mesophyll, spongy mesophyll, xylem, phloem and meristem) and describe their functions |
| Explain how the structure of plant tissues are related to their function within the leaf (plant organ) inc stomata and guard cells |
| Recall the plant parts that form a plant organ system that transports substances around the plant |
| Explain how root hair cells, xylem and phloem are adapted to their functions |
| Describe the process of transpiration and translocation including the role of the different plant tissues |
| Explain how the rate of transpiration can be affected by different factors (inc naming the factors) |
| Describe the role of stomata and guard cells in the control of gas exchange and water loss |
| **SUMMER 1** | PHYSICS TOPIC 2 - ELECTRICITY | 6.2.1 Current, potential difference and resistance |  Draw and interpret circuit diagrams, including all common circuit symbols |
|  Define electric current as the rate of flow of electrical charge around a closed circuit  |
|  Calculate charge and current by recalling and applying the formula: *[ Q = It ]* |
|  Explain that current is caused by a source of potential difference and it has the same value at any point in a single closed loop of a circuit |
|  Describe and apply the idea that the greater the resistance of a component, the smaller the current for a given potential difference (p.d.) across the component |
|  Calculate current, potential difference or resistance by recalling and applying the equation: *[ V = IR ]* |
|  *Required practical 15: Use circuit diagrams to set up and check circuits to investigate the factors affecting the resistance of electrical circuits* |
|  Define an ohmic conductor |
|  Explain the resistance of components such as lamps, diodes, thermistors and LDRs and sketch/interpret IV graphs of their characteristic electrical behaviour |
|  Explain how to measure the resistance of a component by drawing an appropriate circuit diagram using correct circuit symbols |
|  *Required practical 16: use circuit diagrams to construct appropriate circuits to investigate the I–V characteristics of a variety of circuit elements* |

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| **SUMMER 1** | PHYSICS TOPIC 2 - ELECTRICITY | 6.2.2 Series and parallel circuits |  Show by calculation and explanation that components in series have the same current passing through them  |
|  Show by calculation and explanation that components connected in parallel have the same the potential difference across each of them |
|  Calculate the total resistance of two components in series as the sum of the resistance of each component using the equation: *[ R total = R1 + R2 ]* |
|  Explain qualitatively why adding resistors in series increases the total resistance whilst adding resistors in parallel decreases the total resistance |
|  Solve problems for circuits which include resistors in series using the concept of equivalent resistance |
| 6.2.3 Domestic uses and safety |  Explain the difference between direct and alternating voltage and current, stating what UK mains is  |
|  Identify and describe the function of each wire in a three-core cable connected to the mains |
|  State that the potential difference between the live wire and earth (0 V) is about 230 V and that both neutral wires and our bodies are at, or close to, earth potential (0 V) |
|  Explain that a live wire may be dangerous even when a switch in the mains circuit is open by explaining the danger of providing any connection between the live wire and earth |
| 6.2.4 Energy transfers |  Explain how the power transfer in any circuit device is related to the potential difference across it and the current through it |
|  Calculate power by recalling and applying the equations: *[ P = VI ]* and *[ P = I2 R ]* |
|  Describe how appliances transfer energy to the kinetic energy of motors or the thermal energy of heating devices  |
|  Calculate and explain the amount of energy transferred by electrical work by recalling and applying the equations: *[ E = Pt ]* and *[ E = QV ]* |
|  Explain how the power of a circuit device is related to the potential difference across it, the current through it and the energy transferred over a given time.  |
|  Describe, with examples, the relationship between the power ratings for domestic electrical appliances and the changes in stored energy when they are in use |
|  Identify the National Grid as a system of cables and transformers linking power stations to consumers |
|  Explain why the National Grid system is an efficient way to transfer energy, with reference to change in potential difference reducing current  |