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| **SUBJECT KNOWLEDGE AUDIT & TRACKER**  **Science 2022-23** |  | Secondary  PGCE |

**Purpose of the Audit**

Your indications of specialist subject knowledge strengths and areas for development are used as a basis for discussion during your PGCE training.

At the start of the course, the audit will also be used to inform planning for the development of key ‘gap’ areas of subject knowledge, and then in subsequent school placements alongside your School Based Mentor to identify areas of curriculum about which you have less security of knowledge/which need revision. In terms of a tracker, you are able to chart the progression of both your knowledge and application of knowledge over the training year.

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| **Colour & date** | **Pre-course** | **End-SE1** | **End-SE2** | **End-SE3** |
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| **Key Stages 3-4** | | **I don’t know this** | **SK insecure** | **SK secure** | **I can teach this** | **I know several ways to teach this** |
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| **KS3 Working scientifically** | | | | | | |
| **Scientific attitudes** | Objectivity and concern for accuracy, precision, repeatability and reproducibility |  |  |  |  |  |
| Scientific theories change over time |  |  |  |  |  |
| Evaluate risks. |  |  |  |  |  |
| **Experimental skills & investigations** | Ask questions |  |  |  |  |  |
| Develop line of enquiry |  |  |  |  |  |
| Make predictions |  |  |  |  |  |
| Select appropriate type of enquiry |  |  |  |  |  |
| Identify variables |  |  |  |  |  |
| Use appropriate techniques |  |  |  |  |  |
| Make & record observations using range of methods |  |  |  |  |  |
| Apply sampling techniques |  |  |  |  |  |
| **Analysis & evaluation** | Apply mathematical concepts & calculate results |  |  |  |  |  |
| Present observations & data using range of methods |  |  |  |  |  |
| Interpret observations & data |  |  |  |  |  |
| Identify patterns |  |  |  |  |  |
| Draw conclusions |  |  |  |  |  |
| Present reasoned explanations |  |  |  |  |  |
| Evaluate data |  |  |  |  |  |
| Identify random & systematic error |  |  |  |  |  |
| Identify further questions arising |  |  |  |  |  |
| **Measurement** | Understand & use SI units & IUPAC nomenclature |  |  |  |  |  |
| Derive simple equations & carry out calculations |  |  |  |  |  |
| Undertake basic data analysis including simple statistical techniques |  |  |  |  |  |
| **KS3 Biology** | | | | | | |
| **Cells & organisation** | Cells and hierarchical organisation |  |  |  |  |  |
| Cell structure & function, specialisation, structural adaptation |  |  |  |  |  |
| Plant v animal cells |  |  |  |  |  |
| Role of diffusion |  |  |  |  |  |
| **Musculo-skeletal system** | Structure & function skeletal system |  |  |  |  |  |
| Biomechanics |  |  |  |  |  |
| Muscle function |  |  |  |  |  |
| **Nutrition & digestion** | Diet & food types |  |  |  |  |  |
| Calculation of energy requirements |  |  |  |  |  |
| Issues of diet imbalances |  |  |  |  |  |
| Digestive system structure & function |  |  |  |  |  |
| Role of bacteria in gut |  |  |  |  |  |
| Plant photosynthesis, leaf adaptation, reactants and products |  |  |  |  |  |
| **Gas exchange** | Gas exchange system in humans |  |  |  |  |  |
| Mechanism of breathing |  |  |  |  |  |
| Exercise, asthma & smoking |  |  |  |  |  |
| Role of stomata in leaves |  |  |  |  |  |
| **Reproductive systems** | Reproduction in humans, structure & function reproductive system, maturation, fertilisation, gestation & birth |  |  |  |  |  |
| Reproduction in plants, structure & function reproductive system, pollination methods, fertilisation, fruit & seed formation & dispersal |  |  |  |  |  |
|  | Health & drugs |  |  |  |  |  |
| **Respiration** | aerobic and anaerobic respiration in living organisms |  |  |  |  |  |
| Fermentation |  |  |  |  |  |
| Differences between types of respiration |  |  |  |  |  |
| **Interaction** | Interdependence |  |  |  |  |  |
| Role of plants & animals in human food security |  |  |  |  |  |
| Effect of environment on organisms |  |  |  |  |  |
| **Genetics & evolution** | heredity |  |  |  |  |  |
| Chromosomes, genes, DNA |  |  |  |  |  |
| Watson, Crick, Wilkins and Franklin roles |  |  |  |  |  |
| Species differences |  |  |  |  |  |
| variation |  |  |  |  |  |
| Adaptation |  |  |  |  |  |
| biodiversity |  |  |  |  |  |
| **KS3 Chemistry** | | | | | | |
| **Particles** | Particulate nature of matter |  |  |  |  |  |
| Change of state |  |  |  |  |  |
| Properties of states |  |  |  |  |  |
| Dalton atomic model |  |  |  |  |  |
| Atoms, elements, compounds, molecules |  |  |  |  |  |
| Chemical symbols & formulae |  |  |  |  |  |
| Conservation of mass |  |  |  |  |  |
| **Substances** | Purity |  |  |  |  |  |
| Mixtures, inc dissolving |  |  |  |  |  |
| Diffusion |  |  |  |  |  |
| Separation techniques |  |  |  |  |  |
| Substance identification |  |  |  |  |  |
| **Chemical reactions** | Rearrangement of atoms |  |  |  |  |  |
| Representation as Formulae & equations |  |  |  |  |  |
| combustion, thermal decomposition, oxidation and displacement reactions |  |  |  |  |  |
| Acids, alkalis, neutralisation |  |  |  |  |  |
| the pH scale and indicators |  |  |  |  |  |
| reactions of acids with metals to produce a salt plus hydrogen |  |  |  |  |  |
| reactions of acids with alkalis to produce a salt plus water |  |  |  |  |  |
| catalysts |  |  |  |  |  |
| **energetics** | energy changes on changes of state (qualitative) |  |  |  |  |  |
| exothermic and endothermic chemical reactions (qualitative). |  |  |  |  |  |
| **Periodic table** | physical and chemical properties of different elements |  |  |  |  |  |
| principles underpinning the Mendeleev Periodic Table |  |  |  |  |  |
| Periodic Table: periods and groups; metals and non-metals |  |  |  |  |  |
| Prediction of patterns |  |  |  |  |  |
| properties of metals and non-metals |  |  |  |  |  |
| chemical properties of metal and non-metal oxides |  |  |  |  |  |
| **materials** | order of metals and carbon in the reactivity series |  |  |  |  |  |
| use of carbon in obtaining metals from metal oxides |  |  |  |  |  |
| properties of ceramics, polymers and composites (qualitative). |  |  |  |  |  |
| **Earth & atmosphere** | composition & structure of the Earth |  |  |  |  |  |
| the rock cycle and the formation of igneous, sedimentary and metamorphic rocks |  |  |  |  |  |
| Earth as a source of limited resources and the efficacy of recycling |  |  |  |  |  |
| carbon cycle |  |  |  |  |  |
| composition of the atmosphere |  |  |  |  |  |
| production of carbon dioxide by human activity and the impact on climate. |  |  |  |  |  |
| **KS3 Physics** | | | | | | |
| **Energy & fuels** | comparing energy values of different foods (from labels) (kJ) |  |  |  |  |  |
| power ratings of appliances in watts (W, kW) |  |  |  |  |  |
| amounts of energy transferred (J, kJ, kW hour) |  |  |  |  |  |
| domestic fuel bills, fuel use and costs |  |  |  |  |  |
| fuels and energy resources |  |  |  |  |  |
| **Energy changes & transfers** | simple machines; force v movement; product of force and displacement unchanged |  |  |  |  |  |
| heating and thermal equilibrium |  |  |  |  |  |
| energy transfer from the hotter to the cooler one, through contact (conduction) or radiation |  |  |  |  |  |
| use of insulators |  |  |  |  |  |
| processes that involve energy transfer |  |  |  |  |  |
| **Energy systems** | energy as a quantity that can be quantified and calculated; |  |  |  |  |  |
| Conservation of energy |  |  |  |  |  |
| Comparison & description energy types |  |  |  |  |  |
| using physical processes and mechanisms, rather than energy, to explain the intermediate steps that bring about such changes. |  |  |  |  |  |
| **Motion** | Speed, distance, time, quantitative calculations |  |  |  |  |  |
| Representing motion on graphs |  |  |  |  |  |
| Relative motion |  |  |  |  |  |
| **Forces** | forces as pushes or pulls, contact & non-contact forces |  |  |  |  |  |
| Force interaction, force pairs |  |  |  |  |  |
| Resultant force |  |  |  |  |  |
| using force arrows in diagrams |  |  |  |  |  |
| balanced and  unbalanced forces |  |  |  |  |  |
| moment as the turning effect of a force |  |  |  |  |  |
| force-extension linear relation |  |  |  |  |  |
| work done and energy changes on deformation |  |  |  |  |  |
| **Pressure** | Atmospheric pressure |  |  |  |  |  |
| pressure in liquids |  |  |  |  |  |
| pressure measured by ratio of force over area |  |  |  |  |  |
| **waves** | Waves, transvers, superposition |  |  |  |  |  |
| Sound waves, |  |  |  |  |  |
| Auditory range |  |  |  |  |  |
| Pressure waves |  |  |  |  |  |
| Light waves |  |  |  |  |  |
| Absorption, reflection, refraction, scattering |  |  |  |  |  |
| Ray models, pinhole camera, eye |  |  |  |  |  |
| convex lenses |  |  |  |  |  |
| Photosensitive materials |  |  |  |  |  |
| Colour, frequency, dispersion |  |  |  |  |  |
| **Electricity & electromagnetism** | Current electricity |  |  |  |  |  |
| Circuit components |  |  |  |  |  |
| Series & parallel circuits |  |  |  |  |  |
| Voltage/pd |  |  |  |  |  |
| resistance |  |  |  |  |  |
| Static electricity, electron t5ransfer |  |  |  |  |  |
| electric fields |  |  |  |  |  |
| magnetic poles, attraction and repulsion |  |  |  |  |  |
| magnetic fields |  |  |  |  |  |
| Earth’s magnetism, |  |  |  |  |  |
| the magnetic effect of a current, electromagnets, D.C. motors |  |  |  |  |  |
| **Matter** | conservation of material and of mass, and reversibility, in melting, freezing, evaporation, sublimation, condensation, dissolving |  |  |  |  |  |
| similarities and differences, including density differences, between solids, liquids and gases |  |  |  |  |  |
| Brownian motion in gases |  |  |  |  |  |
| diffusion in liquids and gases |  |  |  |  |  |
| chemical and physical changes |  |  |  |  |  |
| **Space physics** | gravity force, |  |  |  |  |  |
| weight = mass x gravitational field strength (g), on Earth g=10 N/kg, |  |  |  |  |  |
| the seasons and the Earth’s tilt, day length |  |  |  |  |  |
| Sun as a star, other stars in our galaxy |  |  |  |  |  |
| light year as a unit of astronomical distance |  |  |  |  |  |
| **KS4 WS** | | | | | | |
|  | Development of scientific thinking |  |  |  |  |  |
| Experimental skills and strategies |  |  |  |  |  |
| Analysis and evaluation |  |  |  |  |  |
| Scientific vocabulary, quantities, units, symbols and nomenclature |  |  |  |  |  |
| **KS4 Maths Skills [see Appendix 3, KS4, p49]** | | | | | | |
|  | Arithmetic and numerical computation |  |  |  |  |  |
| Handling data |  |  |  |  |  |
| Algebra |  |  |  |  |  |
| Graphs |  |  |  |  |  |
| Geometry and trigonometry |  |  |  |  |  |
| **KS4 Biology** | | | | | | |
| **Cell biology** | Prokaryotic and eukaryotic cells |  |  |  |  |  |
| Growth and development of cells |  |  |  |  |  |
| Cell metabolism |  |  |  |  |  |
| Use of mathematics |  |  |  |  |  |
| **Transport systems** | Transport in cells |  |  |  |  |  |
| Transport systems in multicellular organisms |  |  |  |  |  |
| Human circulatory system |  |  |  |  |  |
| Transport systems in plants |  |  |  |  |  |
| Use of mathematics |  |  |  |  |  |
| **Health, disease & medicines** | Health and disease |  |  |  |  |  |
| Communicable diseases |  |  |  |  |  |
| Treating, curing and preventing disease |  |  |  |  |  |
| Non-communicable diseases in humans |  |  |  |  |  |
| Use of mathematics |  |  |  |  |  |
| **Coordination & control** | Nervous coordination and control in humans |  |  |  |  |  |
| Hormonal coordination and control in humans |  |  |  |  |  |
| Plant hormones |  |  |  |  |  |
| Homeostasis in humans |  |  |  |  |  |
| **Ecosystems** | Photosynthesis, including factors |  |  |  |  |  |
| Levels of organisation within an ecosystem |  |  |  |  |  |
| The principle of material cycling |  |  |  |  |  |
| Pyramids of biomass and transfer through trophic levels |  |  |  |  |  |
| Biodiversity |  |  |  |  |  |
| Food yields |  |  |  |  |  |
| **Inheritance, variation & evolution** | Reproduction |  |  |  |  |  |
| The genome and gene expression |  |  |  |  |  |
| Inheritance |  |  |  |  |  |
| Variation & evolution |  |  |  |  |  |
| Selective breeding and gene technology |  |  |  |  |  |
| **KS4 Chemistry** | | | | | | |
| **Structure & properties of matter** | Atomic models |  |  |  |  |  |
| The modern Periodic Table |  |  |  |  |  |
| Properties of transition metals |  |  |  |  |  |
| Structure, bonding and the properties of matter |  |  |  |  |  |
| ionic, covalent and metallic bonding |  |  |  |  |  |
| Structure and bonding of carbon |  |  |  |  |  |
| Bulk and surface properties of matter including nanoparticles |  |  |  |  |  |
| **Chemical reactions** | Chemical symbols, formulae and equations |  |  |  |  |  |
| Identification of common gases |  |  |  |  |  |
| Chemistry of acids |  |  |  |  |  |
| reactivity series of metals |  |  |  |  |  |
| Electrolysis |  |  |  |  |  |
| Redox reactions |  |  |  |  |  |
| **Energy changes** | Exothermic and endothermic reactions |  |  |  |  |  |
| Reaction profiles |  |  |  |  |  |
| Carbon compounds both as fuels and feedstock |  |  |  |  |  |
| Chemical cells and fuel cells |  |  |  |  |  |
| Factors that influence the rate of reaction, including catalysts |  |  |  |  |  |
| Reversible reactions and the concept of dynamic equilibrium |  |  |  |  |  |
| **Organic chemistry** | Homologous series, including alkanes, alkenes, alcohols and carboxylic acids |  |  |  |  |  |
| Simple reactions of alkanes, alkenes and alcohols |  |  |  |  |  |
| Synthetic and naturally occurring polymers, including DNA |  |  |  |  |  |
| **Chemical analysis** | Assessing purity and separating mixtures |  |  |  |  |  |
| Conservation of mass and the quantitative interpretation of balanced equations |  |  |  |  |  |
| Use of amount of substance (mole) |  |  |  |  |  |
| mole in relation to volumes of gases |  |  |  |  |  |
| Determining the concentrations of solutions |  |  |  |  |  |
| Identification of ions by chemical and spectroscopic means |  |  |  |  |  |
| **Chemical & allied industries** | Life cycle assessment and recycling |  |  |  |  |  |
| Fractional distillation of crude oil and cracking |  |  |  |  |  |
| methods of extracting and purifying metals |  |  |  |  |  |
| Using materials |  |  |  |  |  |
| Equilibrium position and rate in industrial processe |  |  |  |  |  |
| Agricultural productivity |  |  |  |  |  |
| Yield and atom economy |  |  |  |  |  |
| **Earth science** | composition and evolution of the Earth’s atmosphere |  |  |  |  |  |
| greenhouse gases |  |  |  |  |  |
| atmospheric pollutants |  |  |  |  |  |
| Earth’s water resources |  |  |  |  |  |
| **KS4 Physics** | | | | | | |
| **Energy** | Energy changes in a system, stored energy in systems |  |  |  |  |  |
| Conservation, dissipation and national and global energy sources |  |  |  |  |  |
| **Forces** | Forces and their interactions |  |  |  |  |  |
| Work done as force x distance, energy transfer |  |  |  |  |  |
| Pressure and pressure differences in fluids |  |  |  |  |  |
| Moments, levers and gears |  |  |  |  |  |
| Uses of mathematics |  |  |  |  |  |
| **Force & motion** | Speed and velocity, speed as distance over time; acceleration; distance-time and velocity-time graphs |  |  |  |  |  |
| Forces, accelerations and Newton’s laws of motion |  |  |  |  |  |
| Safety in public transport |  |  |  |  |  |
| **Waves** | Waves in air, fluids and solids |  |  |  |  |  |
| Waves at material interfaces: applications in exploring structures |  |  |  |  |  |
| **Light & EM waves** | Frequency range of the spectrum |  |  |  |  |  |
| Interactions of electromagnetic radiation with matter and their application |  |  |  |  |  |
| Lenses |  |  |  |  |  |
| Colour and frequency; differential effects in transmission, absorption and diffuse reflection |  |  |  |  |  |
| Black body radiation (qualitative only) |  |  |  |  |  |
| **Electricity** | Current, potential difference and resistance |  |  |  |  |  |
| Series and parallel circuits |  |  |  |  |  |
| Domestic uses and safety |  |  |  |  |  |
| Energy transfers |  |  |  |  |  |
| Static electricity – forces and electric fields |  |  |  |  |  |
| **Magnetism & electromagnetism** | Permanent and induced magnetism, magnetic forces and fields |  |  |  |  |  |
| Magnetic effects of currents and the motor effect |  |  |  |  |  |
| Induced potential, transformers and the national grid |  |  |  |  |  |
| Microphones and speakers; oscillating currents in detection and generation of radiation |  |  |  |  |  |
| **Particle model of matter** | Changes of state and the particle model |  |  |  |  |  |
| Internal energy, energy transfers and particle motions |  |  |  |  |  |
| Particle model and pressure |  |  |  |  |  |
| **Atomic physics** | Nuclear atom and isotopes |  |  |  |  |  |
| Absorption and emission of ionizing radiations and of electrons and nuclear particles |  |  |  |  |  |
| Hazards and uses of radioactive emissions and of background radiation |  |  |  |  |  |
| Nuclear fission and fusion |  |  |  |  |  |
| **space** | Solar system; stability of orbital motions; satellites |  |  |  |  |  |
| Red-shift; the ‘big bang’ and universal expansion |  |  |  |  |  |

**A- Level Chemistry**

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| **Chemistry Topic** | | **I don’t know this** | **SK insecure** | | **SK secure** | **I can teach this** | **I know several ways to teach this** |
| **Amounts of substance** | Avogadro constant and the amount of substance (mole) |  |  | |  |  |  |
| calculation of reacting masses, atom economies, mole concentrations, yields |  |  | |  |  |  |
| **Atomic structure** | structure and electronic configuration of atoms |  | |  |  |  |  |
| ions and isotopes; |  | |  |  |  |  |
| **Bond-ing** | simple covalent, giant covalent, ionic and metallic structures |  | |  |  |  |  |
| permanent and induced dipole–dipole interactions |  | |  |  |  |  |
| Electronegativity |  | |  |  |  |  |
| shapes of simple molecules |  | |  |  |  |  |
| electron pair repulsion theory |  | |  |  |  |  |
| **Energetics** | enthalpy changes |  | |  |  |  |  |
| use of Hess’s law |  | |  |  |  |  |
| use of energetics |  | |  |  |  |  |
| **Kinetics** | collision theory |  | |  |  |  |  |
| Activation energy |  | |  |  |  |  |
| Boltzman distribution |  | |  |  |  |  |
| role of catalysts |  | |  |  |  |  |
| Rate = k[A]m[B]n |  | |  |  |  |  |
| **Equilibria** | Dynamic nature of equilibria |  | |  |  |  |  |
| Qualitative effects of temperature, pressure and concentration changes |  | |  |  |  |  |
| equilibrium constants Kc |  | |  |  |  |  |
| Bronsted–Lowry theory |  | |  |  |  |  |
| Buffer solutions |  | |  |  |  |  |
| pH calculations |  | |  |  |  |  |
| **Redox** | oxidation states and their calculation |  | |  |  |  |  |
| oxidation and reduction as electron transfer |  | |  |  |  |  |
| electrode potentials and their applications |  | |  |  |  |  |
| **Inorganic chemistry** | organisation of elements |  | |  |  |  |  |
| Classification of elements into s, p and d blocks |  | |  |  |  |  |
| characteristic reactions |  | |  |  |  |  |
| Trends in properties |  | |  |  |  |  |
| transition metals, d block trends, reactions with ligands catalytic behaviour |  | |  |  |  |  |
| **Organic chemistry** | Structural isomers and stereoisomers |  | |  |  |  |  |
| Reactions |  | |  |  |  |  |
| Mechanisms |  | |  |  |  |  |
| Single/double covalent bonds, bond polarity and bond enthalpy |  | |  |  |  |  |
| Benzene structure & bonding |  | |  |  |  |  |
| organic synthesis & reactions |  | |  |  |  |  |
| **Modern analytical techniques** | mass spectrometry |  | |  |  |  |  |
| Infra-red spectroscopy |  | |  |  |  |  |
| nuclear magnetic resonance spectroscopy |  | |  |  |  |  |
| chromatography |  | |  |  |  |  |
| analysis, including techniques for the elucidation of structure |  | |  |  |  |  |