Scheme of Work

AQA Level 3 Certificate and Extended Certificate in Applied Science

**Unit 1**: Key Concepts in Science **Unit type:** Externally assessed

**Guided learning hours:** 60

**Guidance notes**

This scheme of work is a plan of what will be covered in each week or session of the learning programme or course.  It will detail over 30 weeks the delivery of the Applied Science course content for Unit 1. The scheme of work will also suggest resources and ideas for practical work that can illustrate the written content.

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| **Synoptic learning and assessment** | |
| **Unit 1: Key Concepts in Science** | **Unit 2: Applied Experimental Techniques** |
| 1a: Cell structure | 1b: The Hill reaction |
| 1b: Transport mechanisms |  |
| 1c: The heart | 1a: Rate of respiration |
| 1d: Homeostasis | 1a: Rate of respiration |
| 1e: Breathing / Cell respiration | 1a: Rate of respiration |
| 1f: Photosynthesis / Food chains | 1b: The Hill reaction |
| 2a: Atomic structure | 2a: Volumetric analysis / 2b: Colorimetry |
| 2b: Periodic Table | 2a: Volumetric analysis / 2b: Colorimetry |
| 2c: Amount of substance | 2a: Volumetric analysis |
| 2d: Bonding and structure | 2b: Colorimetry |
| 2e: Enthalpy | 2a: Volumetric analysis |
| 3a: Useful energy and efficiency | 3b: Specific heat capacity |
| 3b: Electricity and circuits | 3a: Resistivity |
| 3c: Dynamics |  |

| **Week** | **Specification reference** | **Key learning objectives**  Consider inclusion and differentiation  (as appropriate and relevant)  Equality and diversity in blue (to be enhanced by unit teacher as appropriate for learner group) | **Learning activities and resources**  What will be learner-led?  What will be tutor-led?  Topics for plenary?  Homework?  Classroom-based or off-site?  Employer engagement?  Stretch and challenge in red (to be enhanced by unit teacher as appropriate for learner group) | **Plenary**  How will learner progress be checked?  Evidence requirements? | **Skills**  Opportunities for skills development  **Maths in purple**  **English in green**  **Transferable skill opportunities in orange** |
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| 1 | Task 1a  (AO1a)  Cell structure | * the ultrastructure of eukaryotic and prokaryotic cells on electron micrographs, to include nuclei, smooth endoplasmic reticulum (SER), rough endoplasmic reticulum (RER), mitochondria, vesicles, lysosomes, Golgi apparatus, chloroplasts, vacuoles, cell walls, ribosomes (70S and 80S), flagella, nucleoid, plasmid, mesosome, pili, slime capsules * the differences between eukaryotic and prokaryotic cell structure * nucleic acid structure (DNA / RNA) | Each learner is given one organelle to research. Class comes together to pool their findings under the guidance of the tutor. Learners work in groups to identify the organelles on electron micrographs provided. Tutor leads a Q & A session to differentiate between eukaryotes and prokaryotes and a comparison table is developed.  [www.cellsalive.com](http://www.cellsalive.com)  [www.biologycorner.com/worksheets/cellsalive.html](http://www.biologycorner.com/worksheets/cellsalive.html)  Learners’ research nucleic acid structure and notes are made. They use a card game to construct sections of DNA and RNA. The resulting structures are photographed. | Description /  electron micrograph identification of organelles  Comparison table  Observation of learner performance /  photographic evidence | Written communication skills for notes and comparison tables  Research and problem solving |

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| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 2 | Task 1b  (AO1a)  Cell function and measurement | * the functions of nuclei, SER, RER, mitochondria, vesicles, lysosomes, Golgi apparatus, chloroplasts, vacuoles, cell walls, ribosomes, flagella, nucleoid, plasmid, mesosome, pili, slime capsules * calculating magnification or object size using: magnification = observed size   actual size | Each learner researches the function of the organelle they researched the previous week and provides a brief written summary. Class comes together to pool their findings under the guidance of the tutor.  Tutor demonstrates the correct use of a light microscope and how to calculate magnification of any prepared / ready prepared microscope slide (e.g. cheek cell) using a stage micrometer and eyepiece graticule or computer software.  Learner carries out a risk assessment and then the microscopy practical.  [http://www.abpischools.org.uk/page/modules/cellbiology/biology2.cfm?age=Age range 16-19&subject=Biology](http://www.abpischools.org.uk/page/modules/cellbiology/biology2.cfm?age=Age%20range%2016-19&subject=Biology) | Written summaries of organelle function  Observation of learner practical activity and outcomes of calculations | Written communication skills for summaries  Calculating magnification size  Practical skills and health and safety |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 3 | Task 2  (AO1b)  Transport mechanisms | * the structure of cell membranes, as a phospholipid bilayer with proteins interspersed * the function of intrinsic proteins, including their role in facilitated diffusion and active transport * the function of extrinsic proteins | Tutor introduces learners to the structure of cell membranes. Learners label and annotate the various structures on diagrams provided.  Learners undertake a circus of experiments demonstrating diffusion.  [www.biologymad.com/resources/diffusionrevision.pdf](http://www.biologymad.com/resources/diffusionrevision.pdf) | Annotated diagrams  Observation of learner practical activity | Written communication skills for annotations  Practical skills and health and safety |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 4 | Task 3  (AO1c)  The heart | * key structures of the heart including   bicuspid valve, tricuspid valve, mitral valves, sinoatrial node (SAN), atrioventricular node (AVN), Purkinje fibres, bundle of His   * myogenic stimulation of the heart * the role of the SAN, AVN, Purkinje fibres   and bundle of His in cardiac stimulation   * the role of carbon dioxide chemoreceptors   and baroreceptors in controlling heart rate   * artificial pacemakers as treatment for   arrhythmia (abnormal heart rate), and how they work to re-establish normal heart rate   * the advantages and disadvantages of different types of artificial pacemakers | Tutor introduces learners to the structure of the heart and how it functions.  Learners may dissect a pig’s heart to explore the structures. If there are any moral or religious objections to doing this, learners may observe peers carrying out the procedure / watch a video / take apart an anatomical model.  [www.youtube.com/watch?v=yGlFBzaTuoI](http://www.youtube.com/watch?v=yGlFBzaTuoI)  Tutor demonstrates safe use of sphygmomanometer and learners work in groups to measure blood pressure.  Brief tutor-led discussion on artificial pacemakers.  Learners work in small groups to research pacemakers and then class discuss their findings together.  [www.bhf.org.uk/heart-health/treatments/pacemakers](https://www.bhf.org.uk/heart-health/treatments/pacemakers) | Observation of learner practical activity  Outcomes of calculations  Discussion of research findings | Calculating average blood pressure and comparing class results  Oral communication during discussion.  Practical skills and health and safety  Research |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 5 | Task 4a  (AO1d)  The principles of homeostasis and blood glucose regulation | * how homeostasis involves physiological control systems that maintain the internal environment within restricted limits, i.e.   + body temperature range is 35.8°C−37.5°C   + blood glucose range is 82−110 mg/dL   + blood pH range is 7.35−7.45 * negative feedback as a homeostatic mechanism e.g. controlling water retention using anti-diuretic hormone (ADH, also known as vasopressin) produced by the pituitary gland * the roles of the pancreas and liver in regulating blood glucose concentration * the body’s normal system for regulating blood glucose concentration:   + action of insulin in activating enzymes to convert glucose to glycogen   + action of glucagon in activating enzymes to convert glycogen to glucose   + action of adrenaline in activating enzymes to convert glycogen to glucose * the causes of Types I and II diabetes and their control * the control of Types I and II diabetes and their control * how health professionals and patients with diabetes use physiological measurements to inform diagnosis and treatment of diabetes, including the use of:   + - fasting glucose levels     - urine dipsticks     - urine dipsticks     - blood glucose ‘pinprick’ tests | Tutor introduces learners to the concept of homeostasis using examples. The principle of negative feedback is demonstrated and discussed using a given example.  Learners are given incomplete diagrams of the regulation of blood glucose. Completion of diagrams will demonstrate the role of the liver, pancreas and hormones and the process of negative feedback in effective control.  Learners work in small groups to research type I and type II and then class comes together to discuss their findings.  Tutor introduces learners to how diabetes may be diagnosed and monitored.  Tutor demonstrates safe use of dipsticks and blood glucose monitors. Learners work in groups to measure blood sugar.  Learners produce leaflets for homework on diabetes and how it can be tested and monitored by health professionals and patients.  [www.abpischools.org.uk/page/modules/diabetes/?coSiteNavigation\_allTopic=1](http://www.abpischools.org.uk/page/modules/diabetes/?coSiteNavigation_allTopic=1)    Diagrams may be of varying levels of completion depending on ability of individual learners. | Q & A on homeostasis  Completion of diagrams  Discussion of research findings  Leaflet production | Oral communication during discussion  Written communication and spelling during diagram completion and leaflet production  Practical skills and health and safety  Research |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 6 | Task 4b  (AO1d)  Osmoregulation | * the roles of the hypothalamus, pituitary and ADH in osmoregulation * the different parts of the nephron and their roles including:   + Bowman’s capsule as an ultrafiltration unit   + convoluted tubules in selective reabsorption of glucose, sodium ions and water * the roles of the adrenal cortex, convoluted tubules and aldosterone in the reabsorption of sodium ions * the consequences of sodium chloride (salt) deficiency in the short term and the long term effects on health * the circumstances in which certain people may be at risk of losing too much salt * why excess salt in the diet might create health problems * the consequences of excess/deficiency of ions and hormones on health | Tutor introduces learners to the concept of osmoregulation and how control is achieved.  The structure and function of the kidney are introduced using an anatomical model.  Learners complete diagrams to demonstrate the role of nephrons in selective reabsorption.  Learners carry out research on ion/hormone deficiency/excess and combine their findings in a class-generated table.  Learners carry out research into salt deficiency/excess and produce posters for homework.  [www.abpischools.org.uk/page/modules/homeostasis\_kidneys/.cfm?coSiteNavigation\_allTopic=1](http://www.abpischools.org.uk/page/modules/homeostasis_kidneys/.cfm?coSiteNavigation_allTopic=1) | Q & A on osmoregulation  Completion of diagrams  Poster production | Oral communication during discussion  Written communication and spelling during diagram completion, poster and table production  Research |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 7 | Task 6a  (AO1e)  Breathing | * the distinction between breathing and cellular respiration:   + breathing as a physical, external process   + cellular respiration as a chemical, internal process * methods of monitoring the respiratory system (breathing rate and volumes) | Learners are given a brief description of breathing and respiration and are asked to produce a comparison table.  Learners carry out experiments on breathing rates and volumes using spirometers.  Homework worksheets on breathing rates and volumes of varying complexity.  [www.boundless.com/biology/textbooks/boundless-biology-textbook/the-respiratory-system-39/gas-exchange-across-respiratory-surfaces-220/](https://www.boundless.com/biology/textbooks/boundless-biology-textbook/the-respiratory-system-39/gas-exchange-across-respiratory-surfaces-220/) | Comparison table  Observation of learner practical activity  Outcomes of calculations  Completion of worksheets | Calculating average breathing rates and lung volumes and comparing class results  Written communication during comparison table completion  Practical skills and health and safety |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 8 | Task 6b  (AO1e)  Cellular respiration | * how during cellular respiration, adenosine triphosphate (ATP) is produced by phosphorylation, in which a phosphate group is added to a molecule of adenosine diphosphate (ADP) * how ATP is used to release energy for cell activity * the stages in respiration of glucose that result in the production of ATP, and the site of each process:   + glycolysis (in the cell cytoplasm)   + Krebs cycle (in mitochondria)   + electron transfer chain (in mitochondria) * the detailed process of glycolysis * the detailed process of the Krebs cycle * the detailed process of the electron transfer chain * the amount of ATP that can be produced from aerobic and anaerobic pathways * what is meant by basal metabolic rate (BMR) and how it can be determined in a laboratory by direct or indirect methods * the differences in BMR for males and females, and for different age groups of both genders, using secondary data | Tutor introduces cellular respiration and the chemical reactions taking place in all three stages. Learners are asked to develop their understanding of this topic through group/individual research. Learners are given a work booklet to complete which contains questions of varying complexity.  <http://biology.tutorvista.com/cell/cellular-respiration.html>  Learners research what is meant by BMR and calculate it using an online body calculator:  [www.calculator.org/calculate-online/health-fitness/basal-metabolic-rate.aspx](http://www.calculator.org/calculate-online/health-fitness/basal-metabolic-rate.aspx)    or established formulas  [www.bmi-calculator.net/bmr-calculator/bmr-formula.php](http://www.bmi-calculator.net/bmr-calculator/bmr-formula.php) | Q & A on respiration  Discussion of research findings  Completion of work booklet | Calculations of ATP generated and BMR  Analysing secondary data  Written and oral communication for booklet, Q&A and discussion  Research |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 9 | Task 7a  (AO1f)  Photosynthesis | * photosynthesis as a process of organic carbon capture, to include:   + essential raw materials and their sources   + two stages in photosynthesis: light-dependent (water hydrolysed into oxygen and hydrogen) and light-independent (hydrogen combines with carbon dioxide to produce carbohydrate)   + initial conversion to carbohydrates and subsequent conversions to lipids and proteins | Tutor-led introduction to photosynthesis and its importance, building on learners’ previous experience. Tutor introduces learners to the two stages of photosynthesis. Learners are asked to develop their understanding of this topic through group/individual research.  Learners are given a work booklet to complete which contains questions of varying complexity.  [www.bbc.co.uk/bitesize/higher/biology/cell\_biology/photosynthesis/revision/5/](http://www.bbc.co.uk/bitesize/higher/biology/cell_biology/photosynthesis/revision/5/) | Q & A on photosynthesis  Discussion of research findings  Completion of work booklet | Written and oral communication for booklet, Q&A and discussion  Research |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 10 | Task 7b  (AO1f)  Food chains and productivity | * green plants (producers) as the initiators of food chains * efficiency of food chains, to include:   + constraints   + solar, temperature, water nutrient and space availability for plants   + energy transfer out of the food chain through respiration, excretion and movement   + gross primary production (GPP)   + net primary production (NPP)   + biomass / energy pyramids to demonstrate productivity   + advantages / disadvantages of following a meat-free / reduced meat diet | The importance of green plants as initiators of food chains forms the basis of group discussion. The discussion is developed to consider the efficiency of food chains and productivity.  Learners complete worksheets of varying complexity to reinforce learning.  Learners are split into two groups to research and develop arguments for and against  meat-free / reduced meat diets. Groups present their findings and debate the arguments.  [www.scienceaid.co.uk/biology/ecology/food.html](http://www.scienceaid.co.uk/biology/ecology/food.html) | Q & A on food chains and productivity  Completion of worksheets  Presentation and debate | Written and oral communication for worksheets, Q&A, presentation and debate  Research |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 11 | Task 8a  (AO2a)  Atomic structure | * atomic structure in terms of protons, neutrons, electrons, relative mass and relative charge * the terms: atomic (proton) number (Z), mass number (A), isotope and isotopic abundance * electron configurations for atoms and ions up to Z = 36 in terms of shells | Tutor to initiate and then learner-led.  Learners to research basic atomic structure and produce diagrams.  [www.chemguide.co.uk/atoms/properties/gcse.html](http://www.chemguide.co.uk/atoms/properties/gcse.html)  Learners could produce individual booklets (used for revision), using correct scientific nomenclature.  No help from tutor to complete diagrams. | Booklets checked within the group and then by the tutor | Research  Correct scientific nomenclature  Electron configuration |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 12 | Task 8b  (AO2a)  Emission spectra | * the origin of coloured flame emission spectra and of colour in transition metal compounds in terms of electron transmissions   Consideration given to any issues presented by colour-blind learners. | Colours emitted by different chemicals indicate the elements that are present within those chemicals. This can be shown experimentally by using a spectroscope or simply by using a Bunsen burner to produce the individual colours.  Tutor to introduce experimental worksheet and lead discussion on the risk assessment.  Learners to carry out experiments individually, supervised by tutor. Learners should produce an experimental report using appropriate headings.  [www.science-projects.com/fes/FlameEmissions.htm](http://www.science-projects.com/fes/FlameEmissions.htm)  Learners independently develop their own risk assessments. | Group comparison of results and conclusions | Practical skills and health and safety |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 13 | Task 8c  (AO2a)  Relative mass | * calculating relative atomic mass, relative molecular mass and relative formula mass in terms of 12C | Tutor-led introduction to the calculations, then learners carry out calculations.  Using a Periodic Table, learners are to show at least 12 detailed calculations of relative atomic mass, relative molecular mass and relative formula mass, e.g.   |  |  | | --- | --- | | Element | Relative atomic mass | | H | 1 | | C | 12 | | N | 14 | | O | 16 |   [www.bbc.co.uk/schools/gcsebitesize/science/add\_gateway\_pre\_2011/chemical/reactingmassesrev1.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/add_gateway_pre_2011/chemical/reactingmassesrev1.shtml)    Calculations carried out independently and correctly. | Tutor to check calculations | Calculating relative atomic mass, relative molecular mass and relative formula mass |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 14 | Task 9a  (AO2b)  Periodic Table | The Periodic Table:   * that it lists elements in increasing order of proton number * how each row is equivalent to the filling of an electron shell up to two (in row 1) or eight electrons * how each column or group contains elements with the same number of outer shell electrons and thus similar chemical properties * how each row begins with a highly reactive alkali metal (Group 1) and ends with a noble gas (Group 0) * how, across a period (row) properties of elements change from metallic to non-metallic * the properties (including radii, ionisation energy and electronegativity) of:   + the s-block elements   + the d-block metals (including the transition metals and their coloured compounds in solution)   + Group VII, the halogens   + Group 0, the noble gases | Tutor-led introduction to the Periodic Table.  Learners can produce booklets (for revision) with diagrams (used for revision) on the key learning objectives.  [www.dummies.com/how-to/content/the-periodic-table.html](http://www.dummies.com/how-to/content/the-periodic-table.html)  Risk-assessed demonstration by tutor to show the reactivity of different elements.  [www.rsc.org/learn-chemistry/resource/res00000409/the-reactivity-of-the-group-2-metals?cmpid=CMP00000479](http://www.rsc.org/learn-chemistry/resource/res00000409/the-reactivity-of-the-group-2-metals?cmpid=CMP00000479)  [www.s-cool.co.uk/gcse/chemistry/metals-the-reactivity-series/revise-it/properties-of-metals-and-non-metals](http://www.s-cool.co.uk/gcse/chemistry/metals-the-reactivity-series/revise-it/properties-of-metals-and-non-metals)  The booklet can have diagrams and charts included in order to explain different points.  Use more complex questioning. | Learner to compare drawings in their booklets  Q & A on experimental results | Scientific nomenclature in the booklets  Oral communication skills during Q & A session  Working out electron numbers in shells |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 15 | Task 10a  (AO2c)  Amount of substance | * the mole as the amount of a substance that always contains the same number of entities (e.g. atoms, molecules, ions, electrons) * the relationship between mass of substance and amount in moles * the relationship between volume of gas at RTP and STP and amount in moles * concentrations of solutions in terms of   mol dm-3 and g dm-3   * molecular formulas * empirical formulas | Tutor-led introduction to calculations.  Learners to carry out calculations, possibly as an initial test. [www.bbc.co.uk/bitesize/higher/chemistry/calculations\_1/mole/revision/1/](http://www.bbc.co.uk/bitesize/higher/chemistry/calculations_1/mole/revision/1/)Calculations and working out are all correct. | Results of test | Calculations |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 16 | Task 10b  (AO2c)  Balancing equations | * Writing balanced equations for typical reactions including:   + acid-base neutralisation   + thermal decomposition   + acid/metal   + acid/carbonate   + precipitation   + combustion reactions   + plotting and interpreting pH curves | Tutor-led demonstrations of these experiments, with learners possibly carrying out one or two risk-assessed practicals (dependent on time available).  Learners to write balanced equations for each experiment. [www.bbc.co.uk/schools/gcsebitesize/science/add\_ocr\_pre\_2011/chemical\_synthesis/calculationsrev3.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr_pre_2011/chemical_synthesis/calculationsrev3.shtml)[www.chemguide.co.uk/physical/acidbaseeqia/phcurves.html](http://www.chemguide.co.uk/physical/acidbaseeqia/phcurves.html)[www.nuffieldfoundation.org/practical-chemistry/thermal-decomposition-calcium-carbonate](http://www.nuffieldfoundation.org/practical-chemistry/thermal-decomposition-calcium-carbonate) Safe practical work and accurate balanced equations. | Learner plenary of balanced equations  Tutor to check final answers | Balanced equations |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 17 | Task 10c  (AO2c)  Analysing results | * calculating reacting masses based on correct stoichiometries * equivalence point of an acid-base titration * how the choice of indicator for an acid-base titration depends on the types (strengths) of acid and base used and the resulting pH titration curve * calculating unknown concentrations and volumes from results involving volumetric analysis (limited to acid-base titrations) | Tutor to give out experimental worksheets. Learners to carry out an acid-base titration to work out key learning objectives. [www.docbrown.info/page04/4\_73calcs.htm](http://www.docbrown.info/page04/4_73calcs.htm) Safe and accurate practical work. Correct calculations. | Learner plenary of results and calculations | Practical skills and health and safety  Calculations |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 18 | Task 11a  (AO2d)  Bonding and structure | * formulas for common cations * formulas for common anions (sulfate, carbonate, nitrate, hydroxide) * deducing formulas for ionic compounds * ionic bonding and ionic crystal lattices in terms of strong electrostatic forces of attraction * a covalent bond as a shared pair of electrons * multiple bonds, neutral molecules, non-conductors and weak intermolecular forces of attraction * metallic bonding * structures of:   + ionic crystal lattices typified by sodium chloride, magnesium oxide   + metallic lattices typified by magnesium   + covalent structures typified by iodine, methane, carbon dioxide   + giant covalent structures (macromolecular), e.g. diamond, graphite, graphene, fullerene * predicting types of bonding for compounds given their typical properties and vice versa * typical properties based on the type of bonding, particles present and forces between particles * drawing diagrams to represent:   + - a named ionic lattice     - a generalised metallic lattice     - an alloy * giant covalent structures including silicon, graphite, graphene | Learners carry out individual research into cations, anions, the types of chemical bonds and structures in the key learning objectives.  A series of diagrams can be drawn to show and name the different structures. These can be used to predict properties, etc.  [www.chemguide.co.uk/atoms/structsmenu.html](http://www.chemguide.co.uk/atoms/structsmenu.html)  [www.chm.bris.ac.uk/pt/harvey/gcse/struc\_bond\_welcome.html](http://www.chm.bris.ac.uk/pt/harvey/gcse/struc_bond_welcome.html)  Research is thorough and diagrams are accurate; minimal tutor help. | Learner plenary of bond types and names  Comparison of diagrams | Research  Spelling of chemical names |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 19 | Task 11b  (AO2d)  Ionic and covalent properties | * common physical properties of materials related to their structure and bonding, to include:   + electrical conductivity   + melting and boiling point   + volatility   + solubility in water   + non-polar solvents | Tutor-led series of experiments (demonstrations or a circus of experiments).  Learners to note the difference and similarities between ionic and covalent compounds.  Use these properties to predict the type of bonding, particles present and the forces between particles in different compounds.  [www.nuffieldfoundation.org/practical-chemistry/bonding-structure-properties](http://www.nuffieldfoundation.org/practical-chemistry/bonding-structure-properties)  Experiments understood and predictions correct. Accurate comparison of ionic and covalent structures. | Comparison of results and conclusions | Spelling of chemicals  Practical work and health and safety |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 20 | Task 12a  (AO2e)  Enthalpy changes | * energy profiles for exothermic and endothermic reactions * activation energy using an energy profile * types of enthalpy changes from equations (limited to combustion, neutralisation, formation and mean bond enthalpies) * units for molar enthalpy change (kJ mol-1) * enthalpy changes as the heat energy change (at constant pressure) | Tutor to introduce the subject and the experimental worksheets.  Learners will carry out risk-assessed experiments to illustrate enthalpy changes. This will include the molar enthalpy of combustion of a liquid fuel (e.g. ethanol) and the molar enthalpy of neutralisation for a simple acid-base reaction.  [www.docbrown.info/page07/delta1Hc.htm](http://www.docbrown.info/page07/delta1Hc.htm)  Experiments carried out safely, enthalpy changes understood and correct units used. | Comparison of learner results and conclusions | Practical work and health and safety  Spelling of chemicals  Molar enthalpy changes and energy profiles |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 20 | Task 12b  (AO2e)  Enthalpy changes | * enthalpy of formation, enthalpy of combustion and enthalpy of reaction as represented by ∆fH , ∆cH and ∆rxH * the term ‘mean bond enthalpy’ * calculating enthalpy changes based on Hess’s Law cycles * calculating enthalpy changes based on mean bond enthalpies and why these values are only approximate * determining practically the molar enthalpy of combustion of a liquid fuel (e.g. ethanol) * determining practically the molar enthalpy of neutralisation for a simple acid-base reaction | From the experiments, learners will find out the key learning objectives and produce a booklet (used for revision) containing the information in annotated diagrams.  <http://chemwiki.ucdavis.edu/Physical_Chemistry/Thermodynamics/State_Functions/Enthalpy>  No tutor help with calculations and activation energy profiles. | Comparison of experimental results and diagrams | Practical work and health and safety  Spelling of chemicals  Molar enthalpy changes and energy profiles |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 21 | Task 13a  (AO3a)  Useful energy and efficiency | * the meaning of ‘efficiency’ * why efficiency is important and why a device can never be 100% efficient * methods of improving the efficiency of a system or device * the formula   efficiency =  useful energy (or power) output  total energy (or power) input   * the importance of efficiency in making the best use of available energy * ways in which efficiency can be increased in mechanical and thermal systems | Tutor to introduce the subject of the key learning objectives to give examples of systems and devices and efficiency.  Learner-led discussion on how to improve efficiency in given contexts, e.g. engine / car design.  Learners will carry out risk-assessed experiments to illustrate efficiency using a SEP energy meter.  [www.nuffieldfoundation.org/practical-physics/using-energymeter-measure-efficiency-energy-transfer](http://www.nuffieldfoundation.org/practical-physics/using-energymeter-measure-efficiency-energy-transfer)  Results collected from experiments. | Comparison of experimental results and any graphs produced | Practical work and health and safety  Efficiency calculations and formulas |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 22 | Task 13b  (AO3a)  Useful energy and efficiency | * examples of situations where thermal transfer needs to be maximised and situations where it needs to be minimised * the meaning of ‘U value’ * the formula   U = Q  A t ∆T   * experiments related to measurement of efficiency | Tutor-led discussion on where it is necessary to increase/reduce thermal transfer.  Small group discussion relating U and R values to the energy efficiency of building design (e.g. dwellings, public and commercial properties).  Learners will carry out risk-assessed experiments designed to show heat loss.  [www.designcoalition.org/kids/energyhouse/experiments.htm](http://www.designcoalition.org/kids/energyhouse/experiments.htm)  [www.schoolphysics.co.uk/age11-14/General/text/Coursework\_practical\_sample/index.html](http://www.schoolphysics.co.uk/age11-14/General/text/Coursework_practical_sample/index.html) | Learner plenary of results | Practical work and health and safety  Calculations and transposing the efficiency formula |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 23 | Task 13c  (AO3a)  Useful energy and efficiency | * the generation of useful energy through the use of a range of different sources, such as:   + fossil fuels   + nuclear fuels   + renewable fuels such as:   + solar power (both heat and light)   + wind power   + wave power   + tidal power   + traditional hydroelectric power   + geothermal sources   + biomass * the advantages and disadvantages of these sources and their suitability for use in a range of contexts | Learners divide into small groups to research renewable and non-renewable energy sources, giving advantages/disadvantages and applications of varying difficulty. | Each group to give presentations of research and findings | Spelling and communication  Research |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 24 | Task 14a  (AO3b)  Electricity and circuits | * calculating current, voltage, power and resistance in a range of electrical circuits * calculate the heating effect of a current * the formulas   + I = Q/t   + P = IV   + I = V/R   + rate of heat loss = I2R * the behaviour of electric current, voltage and resistance in series and parallel circuits | Learners given worksheets. They undertake a circus of risk-assessed experiments involving current, voltage, power and resistance.  <https://learn.sparkfun.com/tutorials/voltage-current-resistance-and-ohms-law>  Tutor reinforces practical work with worked examples of varying difficulty.  [www.education.leeds.ac.uk/assets/files/research/cssme/ns-tu/voltage\_energy\_power\_in\_electric\_circuits.pdf](http://www.education.leeds.ac.uk/assets/files/research/cssme/ns-tu/voltage_energy_power_in_electric_circuits.pdf) | Practical and theoretical results discussed | Calculating and transposing relevant formulas  Practical work and health and safety |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 25 | Task 14b  (AO3b)  Electricity and circuits | * calculating the total resistance of a circuit which contains resistors in series, resistors in parallel and a combination of both * the formulas   + Rtotal = R1 + R2 + R3 ……   + 1/Rtotal = 1/R1 + 1/R2 + 1/R3 ….. * uses of potential divider circuits | Learners given worksheets. They undertake a series of risk-assessed experiments investigating resistance in series and parallel circuits.  [www.nuffieldfoundation.org/practical-physics/investigating-series-and-parallel-circuits](http://www.nuffieldfoundation.org/practical-physics/investigating-series-and-parallel-circuits)  Tutor reinforces practical work with worked examples of varying difficulty.  <http://hyperphysics.phy-astr.gsu.edu/hbase/electric/resis.html>  Tutor to present learners with a research exercise on the use of potential divider circuits.  [www.physicsnet.co.uk/a-level-physics-as-a2/current-electricity/potential-divider/](http://www.physicsnet.co.uk/a-level-physics-as-a2/current-electricity/potential-divider/) | Practical and theoretical results discussed | Calculating and transposing relevant formulas  Practical work and health and safety  Research |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 26 | Task 14c  (AO3b)  Electricity and circuits | * free electrons and the electrical behaviour of conductors and semiconductors * the effect of temperature on the resistance of conductors and semiconductors * the behaviour of thermistors and light-dependent resistors (LDRs) * graphs of V against I to find resistance * graphs of voltage against current for a range of components including standard resistors, thermistors and lamps | Tutor to present learners with a research exercise on conductors and semiconductors. The research to include:   * free electrons * electrical behaviour * effect of temperature on resistance * behaviour of thermistors and light dependent resistors (LDRs)   Tutor risk-assessed demonstration of voltage against current to find resistance for a range of components.  Learners to draw individual graphs of results.  [www.schoolphysics.co.uk/age14-16/glance/Electricity%20and%20magnetism/Ohms\_law/index.html](http://www.schoolphysics.co.uk/age14-16/glance/Electricity%20and%20magnetism/Ohms_law/index.html) | Comparison of graphs and calculations of resistance | Calculating relevant formulas, drawing and interpreting graphs  Research |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 27 | Task 15a  (AO3c)  Dynamics | * application of Newton’s First Law of Motion to both stationary and moving objects * inertia * Newton’s Second Law of Motion * the formula F = ma * weight = mg as an example of Newton’s Second Law of Motion * representing motion through the use of graphs of displacement against time and velocity against time * calculating the gravitational potential energy of an object * the formula GPE = mgh | Tutor-led discussion on Newton’s First and Second Laws of Motion.  Learners given worksheets. They undertake a circus of basic risk-assessed experiments.  [www.metrofamilymagazine.com/July-2012/Simple-Science-Experiments-Newtons-First-Law-of-Motion/](http://www.metrofamilymagazine.com/July-2012/Simple-Science-Experiments-Newtons-First-Law-of-Motion/)  [www.nuffieldfoundation.org/practical-physics/investigating-newtons-second-law-motion](http://www.nuffieldfoundation.org/practical-physics/investigating-newtons-second-law-motion)  Learners are given data worksheets to produce graphs of displacement against time and velocity against time.  <http://dev.physicslab.org/Document.aspx?doctype=3&filename=Kinematics_AcceleratedMotionDataAnalysisApproach.xml>  Learners given additional worksheets to calculate GPE.  <http://hyperphysics.phy-astr.gsu.edu/hbase/gpot.html>  Homework: learners to identify where Newton’s First and Second Laws can be applied in the workplace. | Learners compare graphs and GPE calculations | Calculating relevant formulas and drawing and interpreting graphs  Practical work and health and safety |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 28 | Task 15b  (AO3c)  Dynamics | * Newton’s Third Law of Motion including its relationship to the Law of Conservation of Momentum * the meaning of ‘momentum’ * the formulas   + p = mv   + F = ∆p / t * calculating the kinetic energy of a moving object * the formula K.E. = ½ mv2 | Learners research and then present an introduction to Newton’s Third Law including the relationship to the Law of Conservation of Momentum. This presentation should include an explanation of momentum.  Tutor-led presentation of the formulas including transposition and worked examples.  [www.physicsclassroom.com/class/energy/Lesson-1/Kinetic-Energy](http://www.physicsclassroom.com/class/energy/Lesson-1/Kinetic-Energy)  [www.bbc.co.uk/bitesize/intermediate2/physics/mechanics\_and\_heat/momentum/revision/1/](http://www.bbc.co.uk/bitesize/intermediate2/physics/mechanics_and_heat/momentum/revision/1/)  Learners are given worksheets of examples of the formulas to calculate.  Stretch and challenge opportunity using increasingly complex calculations of the formulas. | Learner presentations and answers to questions | Research  Oral communication during presentation and spelling  Calculating and transposing relevant formulas |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 29 | Task 15c  (AO3c)  Dynamics | * applying the Law of Conservation of Momentum to a range of situations, including collisions * the motion of objects * the formulas   + (average) v = s/t   + v = u + at   + v2 = u2 + 2as   + s = ut + ½ at2 * calculate the power of a mechanical system * the formula P = E/t | Tutor-led introduction to the Law of Conservation of Momentum and its application to situations including collisions.  [www.physicsclassroom.com/class/momentum/Lesson-2/Momentum-Conservation-Principle](http://www.physicsclassroom.com/class/momentum/Lesson-2/Momentum-Conservation-Principle)  Opportunity for accident investigator(s) from the police / insurance companies to illustrate how the Law applies to road traffic accidents.  Learners are given worksheets of examples of the formulas to calculate.    [www.helpmyphysics.co.uk/kinematiceqns.pdf](http://www.helpmyphysics.co.uk/kinematiceqns.pdf)  Stretch and challenge opportunity using increasingly complex calculations of the formulas. | Comparison of results of calculations | Calculating and transposing relevant formulas  Oral communication |
| **Week** | **Specification reference** | **Key learning objectives** | **Learning activities and resources** | **Plenary** | **Skills** |
| 30 | Revision | Unit 1 workshop revision session  A variety of approaches may be employed depending on the cohort and their requirements | Depending on cohort this could include:   * discussions * worksheets * Q & A * tests.   These may be tutor- or learner-led.  All of the above lend themselves to stretch and challenge opportunities | Outcome of methods employed | Written and oral communication  Calculating and transposing formulas, drawing and interpreting data and graphs |

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