Unit 4: Practical Scientific Procedures and Techniques

Unit overview

|  |  |
| --- | --- |
| Unit 4: Practical Scientific Procedures and Techniques | |
| **Assessment type: Internal** | |
| **Learning Aim** | **Topics** |
| A Undertake techniques to prepare solutions and determine concentrations and purity | A1 Laboratory equipment and its calibration  A2 Preparation and standardisation of solutions using titration  A3 Determination of purity of organic compounds  A4 Evaluating accuracy and reliability using critical thinking |
| B Undertake biological procedures to investigate concentration and distribution of biological components | B1 Colorimetry  B2 Plant growth |
| C Undertake physical procedures to examine energy transfer | C1 Transfer of thermal energy  C2 Transfer of energy through electrical circuits  C3 Transfer of energy using a renewable source |
| D Review personal development of scientific skills for laboratory work. | D1 Personal responsibility  D2 Interpersonal skills  D3 Professional practice |
| Assessment overview  This unit is Internal assessed through a Pearson-Set Assignment Brief (PASB).  Pearson sets the assignment for the assessment of this unit. The PSAB will take approximately 75 hours to complete. The PSAB will be marked by centres and verified by Pearson. The PSAB will be valid for the lifetime of this qualification. | |

Common student misconceptions

Below are some common misconceptions related to the content of this unit by students and ideas for how you can help your learners to avoid and overcome these.

|  |  |
| --- | --- |
| What is the misconception? | How to help learners overcome it |
| Some students may consider the terms concentration and strong to mean the same thing. This is often evidenced during learning aim A. | Provide students with a clear definition regarding the difference between the two keywords.  Some students may benefit from a visual representation, to differentiate between the two keywords |
| Not all students have a clear understanding of the meaning of molarity. Some students may not understand the impact of volume on molarity. | Students may need very clear guidance regarding the definition of molarity. Specific references to molarity and how it is affected by volume may help students to develop a better understanding of this concept. |
| Some students struggle with the concept of freezing/melting point and boiling/condensation point being the same. | Students should be encouraged to think about the behaviour of particles at freezing/melting and boiling/condensation point. Students should consider energy changes that are taking place, along with the behaviour of intermolecular forces. |
| Students may hold misconceptions regarding the polarity of solvents. For example, students may consider that non-polar compounds have the ability to move all components up a chromatography plate. | Provide students with clear guidance regarding the role of polar and non-polar solvents. Students may benefit from a diagrammatic/visual representation of polarity. Students could be provided with appropriate links to resources to support their independent learning. |
| Some students may consider the terms concentration and strong to mean the same thing. This is often evidenced during learning aim A. | Provide students with a clear definition regarding the difference between the two keywords.  Some students may benefit from a visual representation, to differentiate between the two keywords |
| Not all students have a clear understanding of the meaning of molarity. Some students may not understand the impact of volume on molarity. | Students may need very clear guidance regarding the definition of molarity. Specific references to molarity and how it is affected by volume may help students to develop a better understanding of this concept. |

Learning Activities and Resources

This section offers a starting point for delivering the unit by outlining a logical sequence through the unit topics and suggesting practical activities and teacher guidance for covering the main areas of content during guided learning time. Transferable skills are integrated into various activities, with those embedded in a unit indicated by an acronym in square brackets. The acronym combines the letters from the broad skill area and the specific transferable skill, e.g., **[IS-WC]**.

Please note that the activities provided below are suggestions and not mandatory.

| Learning Topic | Activities and guidance for unit content delivery | Resources |
| --- | --- | --- |
| A1  Laboratory equipment and its calibration | **Introduction**  Introduce calibration to students. Incorporate everyday examples of when calibration may be appropriate, e.g. bathroom scales or kitchen scales. Ask students to consider calibration's importance and the consequences of not carrying out appropriate calibration activities. Introduce the concept of zero error and ask students how zero error can be avoided |  |

|  |  |  |
| --- | --- | --- |
|  | * Whole class activity - Use of balances for weighing and associated techniques * Check students understanding of how they would calibrate electronic balances. * Provide students with data from different types of electronic weighing balances. * A range of data ranging from 2 decimal places to 4 decimal places. Introduce the concept of resolution and ask students to consider which set(s) of data relate to the electronic balance with the highest/lowest resolution. * Provide students with a range of known masses. * Students could use the masses to identify the accuracy of the electronic balance that is available in the laboratory. * Students should record this information in a table and clearly state any discrepancy between the known mass, and the reading on the electronic balance. Where possible, provide students with electronic balances of different accuracies and ask students to complete the investigation with each balance. * Lead a whole class discussion to consider how the results of the electronic balance calibration task will be used to inform future methods. How will this information be used to ensure that practical results are accurate and reliable? * Whole class activity – weighing equipment * Introduce the use of appropriate equipment for weighing for example, a weighing boat for measuring the mass of a solid, and a beaker for a liquid. Video clips could be used to demonstrate these techniques. * **Laboratory activity -** Comparing volume measurements of different types of glassware * Students explore the different types of volumetric glassware (beakers, graduated cylinders, pipettes, burettes, and volumetric flasks) and understand their accuracy, precision, and proper use. * Introduction to Volumetric Glassware: * Begin by introducing the different types of glassware, discussing the purpose of each (e.g. beakers for rough measurements, conical flasks, or measuring cylinders for more precise measurements, volumetric flasks for accurate, specific volume measurement). * Volume Comparison: * Fill each piece of glassware with water, carefully measuring the volume in each using a measuring cylinder. * Record the measurements on a data table, noting the type of glassware and the measured volume. * Accuracy Check: * Weigh the water in each piece of glassware using the balance and compare the mass to the theoretical mass based on the volume and density of water (approximately 1 g/mL at room temperature). * If available, use a thermometer to check for any temperature variation, as it can affect volume measurements slightly. * Analysis: * Discuss how the shape of the glassware and the scale increments affect the precision and accuracy of measurements. * Identify which glassware was the most accurate and why, considering how well the measurement matched the known volume of water. * Conclusion: * Students summarise the key differences in precision, accuracy, and appropriate usage for each type of glassware. * Discuss real-world applications for each, such as when it is necessary to use a volumetric flask versus a measuring cylinder, and why precision is important in scientific measurements.   This activity will help students to develop an understanding of the differences in volumetric glassware but also give them hands-on experience with measuring and analysing volumes, which is essential in many laboratory settings.  To identify uncertainty in measurements and calculate the percentage error in volumetric glassware, students could follow this method:   * Practical activity - Identifying instrument uncertainty * Find the manufacturer’s specified uncertainty for the volumetric glassware (e.g., a measuring cylinder, burette, or pipette). This is typically given as a fraction of the instrument's full scale or a fixed value (e.g., ±0.01 mL). If not directly specified, use standard uncertainties such as ±0.1 mL for most common glassware. * Measure the Volume: * Measure the volume using the glassware and record the reading (e.g., volume of liquid in a burette or pipette). * Calculate the Absolute Uncertainty: * Absolute uncertainty is the uncertainty provided by the instrument (e.g., ±0.05 mL). * Calculate the Percentage Error: * Percentage error is calculated by comparing the measured volume to the known or expected volume (or a reference measurement).   This method will provide an understanding of both the precision of the instrument and the accuracy of your measurement relative to a known or true value. Demonstrate how percentage error can be calculated using specific examples.   * Practical activity - Introduce the use of the burette via a demonstration. * Explain that the burette is used for accurately dispensing and measuring the volume of liquids, particularly in titrations. Model how the burette is used safely. * Students could be divided into small groups, each provided with all four pipettes, water, and measuring cylinders. Students use each pipette to transfer 5 mL of water into a measuring cylinder, taking note of any differences in ease of use and accuracy. * For the automated pipette: Set the volume to 5 mL or another specific value for comparison. * For the graduated pipette: Ensure they use the markings for accurate measurement. * For the bulb pipette: Highlight how it delivers a fixed volume. * Students record their observations, including: * Accuracy (how close the volume was to 5 mL) * Precision (consistency of results) * Ease of handling * Situations where each pipette might be most appropriate * Small group activity – strengths and limitations of pipette types. * Arrange the students into small groups. * Allow them to have a group discussion about the strengths and limitations of each pipette type. * Suggest reflective questions, such as: * Why would you use an automated pipette over a teat pipette for small volumes? * In what scenarios would a bulb pipette be preferred over a graduated pipette? | Important of calibration of laboratory equipment  [Importance of Calibration of Laboratory Equipment - GNW Instrumentation](https://www.gnw.co.uk/blog/calibration-of-laboratory-equipment/)  How to calibrate and electronic balance  <https://www.philipharris.co.uk/blogs/secondary/how-to-calibrate-an-electronic-balance>  <https://studyrocket.co.uk/revision/level-3-applied-science-btec/practical-scientific-procedures-and-techniques/use-of-balances-and-weighing>  How to use a weighing boat  <https://www.youtube.com/watch?v=dCbyA-aH6k4>  Chemistry glassware names and uses  <https://www.thoughtco.com/chemistry-glassware-names-and-uses-606047>  Measuring the mass of a liquid  <https://cdn.sanity.io/files/p28bar15/green/6627251a69f6772ab747da14b6eb5dcd9701ae5d.pdf>  Volumetric glassware  <https://www.webassign.net/labsgraceperiod/tccgenchem1l1/glassware/manual.html#:~:text=Four%20main%20types%20of%20volumetric,the%20buret%20and%20the%20pipet>.  Uncertainties inscientific measurements  <https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry_(Petrucci_et_al.)/01%3A_Matter-_Its_Properties_And_Measurement/1.6%3A_Uncertainties_in_Scientific_Measurements>  Quantitative chemistry  <https://www.bbc.co.uk/bitesize/guides/z4x2gwx/revision/3> |
| A2  Preparation and standardisation of solutions using titration | * Whole class teaching and learning - Preparation of a standard solution * Provide students with a specific amount of a substance, for example - Sodium Bicarbonate. * Guide them to dissolve it in distilled water and prepare a solution of a known concentration using a volumetric flask. * Students should ensure that they recorded the mass of the solid that has been added. * The following method could be used – * **Weigh the solute**: Measure the mass of the solute (in grams) using an electronic balance. * **Dissolve the solute**: Add the solute to a volumetric flask. * **Dilute to the mark**: Add solvent (distilled water) up to the calibrated volume of the flask. * Small group activity – calculating concentration of standard solution * Lead a group discussion regarding how to calculate the concentration of the standard solution. * Students may benefit from worked examples. * Students can use this information to calculate the concentration of their own standard solutions. * Laboratory activity – Acid-alkali titration. * Demonstrate an acid-alkali titration. * Ask students to reflect on the earlier burette activity. * Provide students with the opportunity to carry out a rough titration in order to practice their technique. * Laboratory activity - Standardisation of the standard solution * Students can carry out the following practical activity. * Clean and rinse a burette, pipette, and conical flask with distilled water. * Fill the burette with a known concentration of HCL * Rinse the pipette with the standard solution (to be standardized). * To take the measurement * Use the pipette to transfer a specific volume (e.g., 25.00 mL) of the standard solution into the conical flask. * Add 2–3 drops of an appropriate indicator to the flask. * Ask students to carry out a titration * Slowly add the HCl from the burette to the analyte solution while swirling the flask. * Stop adding once the indicator changes colour permanently, indicating the endpoint. * Ask students to record results and repeat. * Record the volume of the end point * Repeat the titration until you obtain at least three consistent titres (within ±0.1 mL). * Ask students to perform calculations * Lead an activity to demonstrate how to calculate the concentration of the HCl. * Students may benefit from worked examples, before using this information to calculate the concentration using their own results. * Laboratory activity - Determination of titration end-point from the colour change of a suitable indicator * Provide students with the opportunity to carry out a titration involving an acid and a base, for example HCl and NaOH. * Small group activity – Appropriate Indicators * Allow students to discuss their method in pairs/small groups. Provide a range of indicators and ask students to research and consider the most appropriate indicator for their practical. * Whole class activity – group discussion * Discuss the importance of rough titrations and the need to carry out repeats. * Ask the students to discuss and feedback on how they will calculate mean titres. * Encourage students to consider how they will manage anomalous results within their data. * Ask students to consider how many repeats they carry out. * Encourage students to design their results table prior to starting the practical activity. * Students can work in small groups to discuss their results and carry out concentration calculations. * Model how the concentration is calculated before students attempt this for themselves * Whole class teaching and learning - Use of stoichiometric ratios from chemical equations * Explain that stoichiometric ratios from chemical equations are used in various ways in chemistry to relate the quantities of reactants and products. * Lead a whole class activity to demonstrate the use of stoichiometric ratios, using symbol equations, For example - CH4​+2O2​→CO2​+2H2​O * Students may benefit from more than one worked example, before being given the opportunity to relate the concept to their own results. * Whole class teaching and learning - Systematic and random errors * Provide students with information about different types of errors. * Lead a whole class discussion focusing on each type of error and ask students to consider how these errors may have impacted their results. * Students may benefit from some scenarios involving different types of errors. * Students could discuss each scenario in small groups and identify the errors. * Students should be encouraged to take an evaluative approach, and to consider how they would reduce such errors in future practical activities. | How to make a standard solution  <https://www.chemicals.co.uk/blog/how-to-make-a-standard-solution?srsltid=AfmBOopeXVxnYxOpQ1XNzW-gStJKqyH7YXTfo2fXS2iQn0Y5S4LXZBvK>  Volumetric titrations  <https://www.bbc.co.uk/bitesize/guides/ztkdd2p/revision/4>  GCSE Revision - Titration calculations  <https://www.youtube.com/watch?v=x8DLLCNMKAs>  Stoichiometry and balancing reactions  <https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_(Inorganic_Chemistry)/Chemical_Reactions/Stoichiometry_and_Balancing_Reactions>  Random error and systematic errors  <https://www.thoughtco.com/random-vs-systematic-error-4175358> |
| A3 Determination of purity of organic compounds | * Whole class teaching and learning activity - Chromatography * Ask students to reflect on their knowledge of chromatography from GCSE/prior learning. Ask students to discuss their understanding of chromatography within small groups. * Students can carry out a research task to identify different methods of chromatography, such as - - * Thin layer chromatography (TLC), * Paper chromatography, * Ion exchange * Gas chromatography (GC), * High-performance liquid chromatography (HPLC) * Laboratory activity - Whole class demonstration * Lead a class demonstration using paper chromatography. This could focus on the identification of amino acids, plant pigments etc. * Describe each stage of the process, emphasising key concepts such as the stationary and mobile phase. * Highlight potential errors that could impact the results, such as not using a pencil for the baseline, or allowing the practical to ‘overrun’. Students should be alerted to any potential risks posed by the method, for example, the use of Ninhydrin in amino acid chromatography. * Where possible, use a visualiser to demonstrate how to measure the distance of the spot and the solvent front. This data could then be used to introduce the concept of Rf values. * Laboratory activity - Chromatography * Provide students with the opportunity to carry out a similar chromatography activity in pairs/small groups. * Students may benefit from carrying out a practical experiment, to allow them to use the practical equipment and identify any potential issues that may impact their results. * Students should use their chromatograms to calculate Rf values, before using published data to identify each compound. * Students can repeat the activity using a different method of chromatography, such as thin layer chromatography. * Students should calculate Rf values and compare the results with those obtained during paper chromatography. * Whole class teaching and learning – results analysis * Lead a class discussion regarding the factors that may impact the results obtained via chromatographic techniques, such as – * Sample loading * Humidity, * Temperature * Nature of solvent * Substrate and product molecule (polarity) * Contamination * Students could consider the factors that may have impacted their own results. An evaluative approach should be taken, with students considering how their method could be adapted to improve the reliability of their results. * Where possible, students could repeat their practical tasks with a revised method. | Paper chromatography plant pigments  <https://www.youtube.com/watch?v=WYLXdQV8FuI>  TLC plant pigments  <https://www.youtube.com/watch?v=N1jiomP3l_E>  Purity and separating mixtures  <https://www.bbc.co.uk/bitesize/guides/z9dfxfr/revision/4> |
| A4 Evaluating accuracy and reliability using critical thinking skills | * Whole class and individual activity – scientific data   Encourage students to critically analyse a set of scientific data, question its relevance, identify patterns, evaluate strengths/weaknesses, and draw conclusions supported by evidence.   * Students could be given printed or digital datasets (can be real-world climate data, medical trial results, or other experiment outcomes). The following resources could be used – * Graphs and charts related to the dataset * Worksheet with guiding questions * Markers and sticky notes (if working on paper) * Ask students: “Can data ever be misleading?” and “How do our biases affect how we interpret data?” * Show two different representations of the same dataset (e.g., a graph with a misleading scale vs. an accurate one). Discuss how presentation affects interpretation. | Analysing experimental data  <https://www.bbc.co.uk/bitesize/guides/zhg3hbk/revision/1> |
| B: Undertake biological procedures to investigate concentration and distribution of biological components | | |
| B1 Colorimetry | * Whole class and individual activity – Colorimeter   Introduce the role of the colorimeter. Students could be shown a demonstration of the colorimeter being used. Alternatively, a video demonstration could be shown   * Laboratory activity – Colorimetry Investigation * Students could work in pairs/small groups to carry out a colorimetry investigation. Students could follow out the following tasks – * Preparation of a series of diluted solutions from a stock solution using serial dilution * Calibrate the colorimeter using solutions produced by serial dilution * Create a calibration curve based on the results * Use the calibration curve to identify the concentration unknown solutions | Colorimetry <https://www.chemistrystudent.com/colorimetry.html>  Colorimetry for Applied Science  <https://www.chemistrystudent.com/colorimetry.html> |
| B2 Plant growth | * Whole class teaching and learning - Biodiversity   Introduce the idea of biodiversity and ask students to consider what this means.   * Students could be encouraged to think back to the content that they may have covered at GCSE/prior learning. * Provide students with an overview of the important of biodiversity. * In small groups students could discuss factors that affect biodiversity. * Students may benefit from prompts or scenario-based questions to provoke and encourage discussion. * Laboratory activity/small group activity – biodiversity investigation * Provide students with a hypothesis that they are going to investigate, for example - ‘If light intensity increases, then the number of daisies in a field will also increase’. * Provide students with the necessary equipment to carry out the investigation. * Students could work in small groups to investigate the hypothesis using quadrat squares. * Students should be encouraged to consider the following points – * How will they select the area to sample - this may be an opportunity to discuss the importance of random sampling * How they will record their data * How many repeats they will carry out * How they will use their data to decide if the hypothesis can be supported * Laboratory activity – plant dissection * Students complete a plant dissection activity in order to view plant tissue under the microscope. * Students could carry out a stem dissection with a view to observing the vascular bundles and the xylem, phloem and sclerenchyma or collenchyma using the microscope. * Students could be shown a demonstration of the method or use an online resource to develop an understanding of the process. * Students should be made aware of the importance of using staining techniques. * Students will produce annotated diagrams of their plant tissue slides, labelling the key organelles and structures. | Why is biodiversity important?  <https://royalsociety.org/news-resources/projects/biodiversity/why-is-biodiversity-important/>  Quadrats -<https://www.bbc.co.uk/bitesize/guides/z9pn6yc/revision/2>  Dissection and microscopy of a plant cell  <https://www.saps.org.uk/teaching-resources/resources/1325/a-level-set-practicals-dissection-and-microscopy-of-a-plant-stem/> |
| C: Undertake physical procedures to examine energy transfer | | |
| C1 Transfer of thermal energy | * Whole class teaching and learning – Heat transfer * Students could be led through a presentation outlining the processes of conduction, convection and radiation. * Encourage students to consider any prior learning in this area. * Students could watch the linked video (or a similar video) before engaging in a small group discussion regarding the differences between conduction, convection and radiation. * Laboratory activity - conduction * Students could investigate conduction by finding out how long it takes different materials to heat up. * This could be achieved by placing wax at the end of each material and timing how long it takes for the wax to melt. * Laboratory activity – cooling curve * Students could investigate the rate of cooling in a beaker of water and use the data to construct a cooling curve. Students could be encouraged to consider the following points – * What volume of water will be used? * What will the starting temperature be? * How often will the temperature be recorded? * When will the student stop recording the data? * Will the investigation be repeated? * Individual activity – Cooling curve * Students could construct their own cooling curve, using the data from the cooling of water investigation. * Students could use their cooling curve to identify the general rate of cooling at different points. * Whole class teaching and learning – rate of cooling   Model an example of using a cooling curve to calculate the rate of cooling using a gradient.   * Demonstrate how a tangent can be drawn in order to calculate the rate of cooling. * Students could be given the opportunity to complete some practice examples of calculating the rate of cooling using a tangent. * A video example could also be used. * Individual activity/Paired activity – Calculate rate of cooling * Students should be given the opportunity to calculate the rate of cooling at three different points on their cooling curve. * Students could work in pairs and peer assess each other’s calculations. * Individual activity/laboratory activity   Students could work independently to research the concept of specific heat capacity.   * Students should be guided to identify how specific heat capacity is calculated. * Students could investigate the specific heat capacity of different liquids using a calorimeter. * Students can apply the equation for specific heat capacity to their own results. | Conduction convection and radiation  <https://www.youtube.com/watch?v=Eizsm5V8c_c>  Heat Transfer  <https://www.bbc.co.uk/bitesize/guides/zr7j382/revision/2>  Tangent on a cooling curve  <https://www.youtube.com/watch?v=Ne-cxsjHPIM> |
| C2 Transfer of energy through electrical circuits | * Laboratory activity – circuits   Students will construct series and parallel circuits and measure voltage and current.   * Provide students with circuit components: a power supply, voltmeter, ammeter, switch, lamp, variable resistor, thermistor, and light-emitting diode (LED). * Ask them to draw circuit diagrams for a series and parallel circuit before setting them up. * Have students build both circuits and measure voltage and current at different points using a voltmeter and ammeter. * Students should compare their measurements and discuss how voltage and current behave in each type of circuit. * Laboratory activity - resistance * Provide students with five wires of the same material but different cross-sectional areas. * Using a micrometer, students should measure the diameters of the wires and record their values. * Set up a circuit with a power supply, ammeter, voltmeter, and a single wire. * Measure the resistance of each wire by recording voltage and current, then calculate resistance using **R = V/I**. * Using the formula **ρ = RA/L**, students should calculate the resistivity of the wire material. * Laboratory activity – resistance * Provide students with thermistors, LEDs, and filament lamps. * Ask students to measure the resistance of each component at room temperature using an ohmmeter. * Gradually change the temperature using a heat source or by cooling with ice packs and observe how resistance changes. * Have students analyse and discuss their results, focusing on why thermistors and filament lamps behave differently compared to normal resistors. | Series and parallel circuits  <https://www.bbc.co.uk/bitesize/guides/z437hyc/revision/1>  Electrical resistivity  <https://qualifications.pearson.com/content/dam/pdf/A%20Level/Physics/2015/teaching-and-learning-materials/AS-and-A-leve-Physics-Core-Practical-2---Electical-Resistivity-(Student,-Teacher,-Technician-Worksheets).pdf>  Resistance in different diameter wires  <https://web.physics.ucsb.edu/~lecturedemonstrations/Composer/Pages/64.12.html>  Thermistor demonstration  <https://www.youtube.com/watch?v=yQCfitTm1io&scrlybrkr=2ad47653https://www.youtube.com/watch?v=yQCfitTm1io&scrlybrkr=2ad47653> |
| C3 Transfer of energy from a renewable resource | * Laboratory activity/paired activity – solar panels * Students could investigate solar panels by varying the distance of a light source from the panel and measuring the voltage at each distance. * Students could investigate other factors such as the angle of the solar panel and the colour of the light. * Students could produce graphs to identify trends and relationships between voltage and experimental conditions. * Students could work in pairs to consider their results and decide on the best conditions for maximising solar power output. Students could be encouraged to refer to their results from the previous practical activity. * Whole class and individual activity * Students prepare a presentation to focus on the factors that improve the power generation of a solar panel. Students present their ideas to the rest of the class, before answering any questions from other members of the group. | Investigating the factors affecting the output of a solar panel  <https://www.wjec.co.uk/media/gb1pg5cp/investigation-of-the-factors-affecting-the-output-from-a-solar-panel.pdf> |
| D: Review personal development of scientific skills for laboratory work | | |
| D1 Personal responsibility | * Small group activity – health and safety * The class could be divided into small groups (3–4 students per group). * Provide each group with a scenario card that outlines a lab situation. For example: * Scenario A: A student notices a peer not following safety protocols during an experiment. * Scenario B: A student accidentally makes an error in a procedure and must decide how to address it. * Scenario C: A team is preparing for a lab experiment and needs to distribute roles and ensure that each member understands their responsibilities. * Each group spends 5 minutes discussing their scenario and then role-playing the situation, focusing on: * Clearly defining each team member’s role and responsibilities. * Demonstrating safe working practices and adherence to protocols. * Discussing and showing accountability for decisions made during the scenario * After each role-play, have a brief class discussion. Ask each group to share what they learned about accepting personal responsibility and working safely in a science lab setting. * Individual activity – safe working practices * Students reflect on their practical tasks and consider how they have adhered to procedures and protocols, as well as considering how they have adopted safe working practices. Students could produce a written report or summary to outline how they have developed these skills. | Science CLEAPPS  <https://science.cleapss.org.uk/>  Laboratory safety rules  <https://safety.admin.ox.ac.uk/laboratory-safety-rules> |
| D2 Interpersonal skills | * Project based learning – mini research project * Present a scenario where each group must design a mini research project (e.g., investigating a simple scientific question) with limited resources and a strict time limit. * Outline available “resources” (e.g., mock lab equipment, data sets) and any safety guidelines that must be followed. * Planning Session in small groups, have students create a brief project plan that includes: * A timeline for key tasks * Allocation of resources * Safety protocols they plan to observe * Encourage discussion about strategies to maximise efficiency and minimise waste. * Allow each group a fixed period (e.g., 10 minutes) to simulate the project execution, checking in on their progress. * Instruct groups to record any challenges they encounter, especially related to time management or resources used * Students can consider the following questions- * What strategies worked best? * How did planning help in managing time and resources? * What safety behaviours were important during the simulation? * Lead a brief discussion on the importance of adapting plans based on constructive feedback and unexpected challenges. |  |
| D3 Professional practice | * Small group activity – real-world scientific problems   In small groups, choose a real-world scientific problem (e.g., plastic pollution, antibiotic resistance, or food waste).   * Students could – * Identify the root causes using scientific reasoning. * Propose a step-by-step solution, explaining the scientific methods used. * Present their findings in a short presentation or poster * Individual activity – self reflection * Students could – * Reflect on their current skills and areas for improvement as a future scientist. * Create a personal development plan using a SMART goal (Specific, Measurable, Achievable, Relevant, Time-bound). * Identify necessary resources, activities, and milestones. * Share their plan with a peer for feedback and discuss ways to track progress. | Skills you can develop  <https://help.open.ac.uk/science-careers/skills-you-can-develop> |
| D1, D2 & D3 | * Individual activity – self reflection * Students reflect on the skills and knowledge that they have acquired over the course of the unit and produce a summary report/presentation to showcase this. * Students could be encouraged to think about each of the practical tasks, along with any other key skills/transferable skills/competencies that they have developed. * Students could be provided with a set of prompts such as – * What skills did you develop in each task? How did this build on your existing skills/knowledge? * What would you like to develop further? Are there any areas that you found difficult? * What transferable skills have you developed, and how might these be beneficial as you take the next steps in your education/career? |  |

Delivering signposted transferable skills

Signposted transferable skills are not mandatory for the delivery of the unit, and it is therefore your decision to deliver these skills as a part of the qualification. Below we have provided some ideas of teaching and learning activities that you could use to deliver these skills if you chose to.

|  |  |
| --- | --- |
| Transferable skills | Ideas for delivery |

|  |  |
| --- | --- |
| MY - PGS | * Laboratory activity – demonstrating managing yourself skills * Students can demonstrate this skill by working safely, adhering to protocols and following instructions. Students can also demonstrate an ability to consider the safety of others during practical tasks. * When reflecting on the skills and knowledge that they have developed, students can demonstrate that they are able to reflect and evaluate their own personal strengths and areas for development. * Laboratory activity – resilience * Students can demonstrate resilience when carrying out more complex practical activities, as well as when completing complex tasks such as titration calculations. Students can demonstrate their ability to persevere and overcome any barriers. * During Learning aim D, students can reflect on how their skills and knowledge may inform and benefit them as they move into their chosen careers. Students can focus on the transferable skills that they have acquired, and how these will support them moving forwards. |

Resources

This section has been created to provide a range of links and resources that are publicly   
available that you might find helpful in supporting your teaching and delivery of this unit in the qualification. We leave it to you, as a professional educator, to decide if any of these resources are right for you and your students, and how best to use them.

Pearson is not responsible for the content of any external internet sites. It is essential that you preview each website before using it to ensure the URL is still accurate, relevant, and appropriate. We’d also suggest that you bookmark useful websites and consider enabling students to access them through the school/college intranet.

### Websites

BBC Bitesize. (n.d.). *GCSE revision - Titration calculations*. Retrieved from<https://www.youtube.com/watch?v=x8DLLCNMKAs>

BBC Bitesize. (n.d.). *Quantitative chemistry*. Retrieved from<https://www.bbc.co.uk/bitesize/guides/z4x2gwx/revision/3>

BBC Bitesize. (n.d.). *Series and parallel circuits*. Retrieved from<https://www.bbc.co.uk/bitesize/guides/z437hyc/revision/1>

BBC Bitesize. (n.d.). *Volumetric titrations*. Retrieved from<https://www.bbc.co.uk/bitesize/guides/ztkdd2p/revision/4>

Chemistry LibreTexts. (n.d.). *Stoichiometry and balancing reactions*. Retrieved from [Stoichiometry and Balancing Reactions - Chemistry LibreTexts](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_(Inorganic_Chemistry)/Chemical_Reactions/Stoichiometry_and_Balancing_Reactions)

Philip Harris. (n.d.). *How to calibrate an electronic balance*. Retrieved from [How to calibrate an electronic balance | Philip Harris](https://www.philipharris.co.uk/blogs/secondary/how-to-calibrate-an-electronic-balance)

Royal Society. (n.d.). *Why is biodiversity important?* Retrieved from [Why is biodiversity important? | Royal Society](https://royalsociety.org/news-resources/projects/biodiversity/why-is-biodiversity-important/)

Study Rocket. (n.d.). *Use of balances and weighing*. Retrieved from [Use of Balances and Weighing – Level 3 Applied Science BTEC Revision – Study Rocket](https://studyrocket.co.uk/revision/level-3-applied-science-btec/practical-scientific-procedures-and-techniques/use-of-balances-and-weighing#:~:text=Everything%20you%20need%20to%20know%20about%20Use%20of,totally%20free%2C%20with%20assessment%20questions%2C%20text%20%26%20videos.)

ThoughtCo. (n.d.). *Chemistry glassware names and uses*. Retrieved from [Lab Glassware Names and Uses](https://www.thoughtco.com/chemistry-glassware-names-and-uses-606047)

Sciencenotes. (n.d.). *Random error and systematic errors*. Retrieved from [Systematic vs Random Error - Differences and Examples](https://sciencenotes.org/systematic-vs-random-error-differences-and-examples/)

YouTube. (n.d.). *How to use a weighing boat*. Retrieved from<https://www.youtube.com/watch?v=dCbyA-aH6k4>

YouTube. (n.d.). *Thermistor demonstration*. Retrieved from<https://www.youtube.com/watch?v=yQCfitTm1io>

ChemTribe. (n.d.). *Volumetric glassware*. Retrieved from [Volumetric Flasks: Types, Sizes, Uses, Accuracy, & Safety - ChemTribe](https://chemtribe.com/volumetric-flasks/)

### Pearson paid resources also available

* Pearson Student book
* ActiveBook (a digital version of the Student Book, via ActiveLearn Digital Service)
* Digital Teacher Pack (via ActiveLearn Digital Service)

June 2025

For information about Pearson Qualifications, including Pearson Edexcel   
and BTEC qualifications visit [qualifications.pearson.com](http://qualifications.pearson.com/)

Edexcel and BTEC are registered trademarks of Pearson Education Limited

Pearson Education Limited. Registered in England and Wales No. 872828  
Registered Office: 80 Strand, London WC2R 0RL.

VAT Reg No GB 278 537121