Unit 2: Principles and Applications of Chemistry I

Delivery guidance

Scientists and technicians working in the chemical industry need to have an understanding of atoms, electronic structure and bonding. This forms a basis for being able to understand the properties of substances and also calculating reacting quantities, which is essential for all aspects of synthesis and production. This unit covers these key concepts of chemistry.

Learners will develop an understanding of how the position of elements in the periodic table is determined by their atomic and electronic structure, and why the physical properties of substances are related to their bonding and structure. Learners will also gain insight into the methods of extracting elements from their compounds, and an understanding of why this is also determined by the position in the periodic table. They will then be in a position to work out reacting quantities for chemical reactions, applying this to chemical synthesis as well as gravimetric and volumetric techniques.

Learners require access to laboratory facilities to carry out practical activities which investigate the rate of chemical reactions, the concept of equilibrium and quantitative analysis involving gravimetric and volumetric techniques. Visits to organisations (government and/or commercial) that are involved in a range of chemical techniques would be advantageous.

Approaching the unit

Learners will need to understand that, while matter exists in three states, the substances that make up matter can exist as elements, compounds or mixtures. They should be aware that elements consist of one particular type of atom, which is made up of a certain combination of subatomic particles that are fundamental to all atoms. The learners should also understand that one or two elements can chemically combine to form compounds where the former are in definite proportions and have defined properties.

Learning aim A is primarily concerned with the structure of atoms in terms of the arrangement of subatomic particles, and how this determines the properties of an element and its position in the periodic table. It explores the periodic table, from its development to the present form which identifies all known elements in terms of the symbol, atomic number and mass number, as well as the groups, periods and blocks that they occupy. Learners will also identify that metals will be found to the left and non-metals to the right, and have an awareness that some elements can have properties relating to both. A key concept is for learners to be able to distinguish the three main types of subatomic particles in terms of their mass, charge and position in the atom, and the role that they play in determining the size of the atom and position of the element in the periodic table.

They will also investigate the notion that atoms of elements can vary in their mass number and this must be taken into account when determining the relative atomic mass (RAM) of the element. Additionally, learners will have the opportunity to investigate how electrons are arranged in atoms in terms of shells, subshells and orbitals, and understand how this relates to the chemical properties of the element. This learning aim also requires that learners can cite evidence for aspects of atomic structure such as the mass spectra and ionisation energies.

Learning aim B explores how chemical bonding is brought about by the need for atoms to acquire a full outer shell of electrons which is a more stable arrangement than that in the single atom. Learners will come to understand that this is the reason why most elements do not exist as single atoms, and why they combine to form compounds. A key concept is that learners should understand that while atoms combine to form molecules they do so in a way that minimises electron repulsions, and this determines molecular shape. Another critical concept for learners to grasp is that while the bonding between the constituent atoms has resulted from the sharing of electrons, the latter are not always equally shared, depending on the electronegativity of the atoms involved. This can give rise to bond polarity and ultimately to interactions between different molecules. These interactions have a particular impact on the physical properties of substances, such as melting and boiling point. There is an opportunity for some practical investigation, especially in relation to comparing the properties of certain metals, non-metals (simple molecular and giant molecular) and ionic substances.

Learning aim C is concerned with the properties of elements in the periodic table, how they change within their particular group and the implications for the methods of extraction used. The learners will investigate the chemical and physical properties of the s block elements (Groups 1 and 2), the halogens (Group 7), the noble gases (Group 0) and the transition elements (d block). Again there is an opportunity here for a certain degree of practical activity, which must be conducted in a safe manner. They must be able to extend their understanding of bonding to the concept of oxidation and reduction, and be able to identify when an element has been oxidised or reduced and when it can act as a reducing or oxidising agent. They should also be aware that the ability of elements to act as oxidising or reducing agents is related to their position in the periodic table and trends discussed elsewhere. There is also some further opportunity for practical investigation and learners should understand the importance of oxidation and reduction in the extraction of elements from their compounds.

Learning aim D is primarily aimed at enabling the learner to determine reacting quantities in chemical reactions, whether for synthetic or analytical purposes. From previous learning aims they will understand that relative atomic mass (RAM) is derived from a weighted mean of the isotopic masses for that element and the relative molecular (RMM) or relative formula (RFM) mass of a compound can be calculated from the sum of the relative atomic masses of all the elements in the compound. This aim requires them to be able to apply the mole concept to quantify actual masses of substances that can be used in chemical reactions. Ideally there should be considerable practice in converting moles to mass and vice versa for elements and compounds and using it to produce solutions of known concentration. Learners should go on to apply this to determining the amount of reactants required or product formed from a balanced chemical equation. There is an opportunity for practical investigation by further applying the mole concept and the determination of reacting quantities to gravimetric and volumetric analysis.

Assessment Model

Learning aim	Key content areas	Recommended assessment approach
A Understand how atomic and electronic structure influence the arrangement of elements in the Periodic Table	**A1** The Periodic Table and atomic structure **A2** Electronic structure	
B Understand how bonding and structure influence physical properties of substances	**B1** Bonding and structure **B2** Molecular shape, polarity and intermolecular forces	
C Investigate how the properties of elements change in the Periodic Table and methods of extraction from compounds	**C1** The s block elements **C2** The halogens **C3** Transition metals **C4** Noble gases **C5** Reduction and oxidation **C6** Extraction of elements	This unit is assessed through a Pearson Set Assignment.
D Be able to determine reacting quantities in chemical reactions	**D1** Reacting quantities **D2** Gravimetric and volumetric techniques	

Assessment guidance

There are 60 guided learning hours assigned to the unit, of which 22 hours will be required for assessment.

The unit is assessed by a Pearson Set Assignment. The assessment is set by Pearson and must be taken under controlled conditions before it is marked by tutors.

Set assignment units are subject to external standards verification processes common to all BTEC units. By setting an assignment for some units, Pearson can ensure all learners take the same assessment for a specific unit.

Learners are permitted to re-sit set assignment units during their programme.

Set assignments are available from September each year and are valid for one year only.

Delivery must cover all the unit content and prepare learners to produce evidence to meet the assessment criteria and assessment guidance in preparation for taking the Pearson Set Assignment.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 2: Principles and Applications of Chemistry I

Introduction

This unit gives learners the opportunity to develop their knowledge, skills and understanding in the basic principles of chemistry, covering some of the key chemistry concepts in atomic structure, bonding, the Periodic Table and reacting quantities. The fundamental knowledge, practical skills, transferable skills – for example, organisation, self-assessment and problem-solving, and the ability to interpret data – developed in this unit will help learners build the confidence to undertake the more complex practical techniques involved in higher education science courses such as biochemistry, chemistry, forensic science and environmental science.

Learning aim A – Understand how atomic and electronic structure influence the arrangement of elements in the Periodic Table

- For learning aim A, the teaching focuses on two main areas: the periodic table and the structure of the atom and the electronic configuration of atoms. Begin the learning aim with a short quiz which firstly enables learners to test their previous knowledge of the Periodic Table, e.g. identifying elements from the symbols (or vice versa), charges and masses of the subatomic particles, etc. This will enable the teacher to gauge the level of knowledge and understanding that learners currently have and build a foundation for moving forward with the topic. There is some opportunity to recap on relevant material that would normally be expected to have been covered at the previous level, and perhaps address any gaps. Move forward from here by asking the learners to identify substances that are elements, compounds or mixtures from a list. They should be able to define an element as consisting of one type of atom and which cannot be broken down any further by chemical means.
- For A1, learners should be aware that the current Periodic Table represents all known elements. They could perhaps watch a video that gives a brief overview of how the present day Periodic Table was arrived at, citing developments by Dalton, Mendeleev etc. Give learners an opportunity to identify the key features of the periodic table: element symbols, atomic number, mass number/relative atomic mass, groups, periods, blocks, metallic elements, non-metallic elements and those that have a degree of metallic and non-metallic character.
- From this there should be a more detailed look at atomic structure in terms of the arrangement of subatomic particles. (They will know the relative charges and masses of the three types of subatomic particles, but they should be able to appreciate the differences in terms of the actual values.) At this stage they could draw the atomic structures of the elements in the first three periods, using the Bohr model. They will note that, as groups are descended, the atomic radius gets larger due to the additional shell, but they should also be given values for atomic radii across a period so they can observe a decrease. Following on there will be some discussion on the part played by the increasing effective nuclear charge as electrons are added into the same shell, and how this is offset in anions due to an increased electron repulsion. (Again, it is useful to look at values for atomic and ionic radius from published sources.)

- Learners will have noted from the periodic table that the RAM is not always a whole number, despite the fact mass number should be. They should have access to mass spectra to demonstrate that the atoms of elements can vary in the number of neutrons and produce different isotopes (as represented by the different peaks in the mass spectrum). They can use the mass spectrum for a range of elements to identify the isotopes in terms or their mass and abundance, and use this to calculate the relative atomic mass of the element. This can be supplemented by further activities involving calculation of RAM from isotopic masses and abundances.
- A2 largely focuses on the electronic configuration of atoms. Learners will know that electrons are arranged in energy levels or shells but here they will be introduced to subshells and orbitals. They will also be aware that electrons orbit the nucleus but there should now be some recognition that there could be an increasing tendency for repulsion as they are all negatively charged. There should be an appreciation that only two electrons can orbit in the same pathway at a given time and as the number of orbits (i.e. orbitals) increases, different shapes for these are required – i.e. shapes of s, p and d orbitals and the maximum number of orbitals and hence electrons possible in each subshell. At this stage, encourage learners to research the building of electron configurations noting the rules involved – i.e. Aufbau, Hund's Rule, Pauli's Exclusion principle.
- Discussion could follow regarding electron spin pairing in orbitals, greater stability of filled and half-filled subshells, initial lower energy of the 4s subshell relative to the 3d, etc. Learners can then proceed to build up the s p d electronic configuration for all the elements from hydrogen to krypton, taking on board the rules and exceptions. They can then investigate the electronic configurations of various anions and cations.
- The final topic in this learning aim is ionisation energy. Learners should be able to define the first and successive ionisation energies (IE) of elements and write equations for these. (It is important to emphasise the correct use of the state symbols.) Although the mole concept is dealt with in more detail in a later learning aim, they should understand that the values quoted for IE (in KJ) represent molar quantities. Learners can then plot the successive IE values for some period 2 and 3 elements and relate the plot to their electronic configurations.
- Following on from this could be an exercise whereby the learners use successive ionisation energies to predict the type of ions formed by unidentified elements. Then give them (or have them obtain from their own research) the plot of the first ionisation energies for all elements from hydrogen to, say, krypton. Using this, learners can investigate how this gives further evidence for theories and rules relating to electronic configuration. In particular, they can see how anomalies such as from Be to B and N to O back up the idea of filled and half-filled subshells being more stable than partially filled ones.

Learning aim B – Understand how bonding and structure influence physical properties of substances
• Learning aim B is concerned with bonding and how this impacts on the properties of substances and ultimately their applications. Again, the aim could be introduced through a quiz which seeks to gauge the learners' knowledge and understanding to date and identify any gaps that may need to be addressed before starting on the further content. • Learners should have an understanding that elements partake in bonding in order to achieve a full and more stable outer shell configuration. They should also realise that for this reason most elements do not exist naturally as single atoms, preferring to exist in simple molecular structures or giant lattice arrangements whereby atoms of the element are somehow bonded to each other. They should also realise that many elements can only be found naturally in compounds in which their atoms are bonded to those of other elements. This learning aim also looks at how the bonding arrangement in molecules affects their structure and how it can contribute to interactions between different structures (i.e. intermolecular forces). • For B1, explain the different types of bonding – ionic, covalent and metallic – and the properties of the substances formed as a result. The learners should understand that metallic elements with low numbers of electrons in their outer (valence) shells tend to give up these to attain the more stable configuration. They can do this by giving up electrons to a non-metal which only need one or two to make up a full outer shell but with regard to each other, they all give up their valence electrons to form a 'sea' of delocalised electrons which the resulting metal cations become attracted to. • A YouTube video at this stage may help learners to understand and be able to illustrate metallic bonding in terms of the attraction between local used electrons and cations and properties, especially conductivity, malleability, ductility, etc. The focus can then shift to ionic bonding, whereby metal atoms transfer their outer electrons to a non-metal to form positively and negatively charged ions respectively. Learners should be able to draw dot and cross representations of simple ionic compounds, showing the correct charges and combinations. They should understand that the resulting compounds are held together by the electrostatic attraction between the oppositely charged ions in a giant lattice structure (in teaching this, brief reference should be made to coordination number and body/face-centred cubic packing). Learners will need to be able to describe and explain the properties associated with ionic substances – i.e. high melting and boiling points, electrical conductivity when molten or in solution but not as solids, etc. • The final type of bonding learners need to be able to explain is covalent, whereby atoms of (largely non-metallic) elements share electrons to achieve a full and more stable valence shell. They should understand that the valence electrons of each atom sharing are attracted to the nucleus of the other. Again, the learners should be encouraged to practise drawing dot and cross diagrams which show the covalent bonding arrangement in simple molecular substances (elemental and compound). They will recognise that sharing a pair of electrons gives rise to a single bond, two pairs a double bond and three a triple bond. The learners must also understand that covalent bonding can give rise to giant structures such as in graphite, graphene, diamond and silica. As for the other types of bonding, they should be able to describe and explain the properties of covalent substances and compare simple

molecular with giant covalent. In relation to the latter, learners should be able to draw comparisons for the two carbon allotropes, diamond and graphite.

- For B2, explain how the bonding arrangement in molecules affects their structure and how that and bond polarity can contribute to interactions between different structures, including intermolecular forces such as induced (temporary) dipole, permanent dipole and hydrogen bonding. Activities involving ball and stick models are useful for helping learners to understand how molecular shape can be determined by the electron arrangements within the molecule. This could be augmented by using computer 3D images of such. Learners should understand the magnitude of electron repulsion with regard to bonding and non-bonding electrons in determining molecular shape. They can make or draw models of molecules which are linear, trigonal planar, tetrahedral, pyramidal and octahedral, and develop an appreciation of how these arise from the bonding repulsions.
- Following on from this, introduce the learners to the concept of electronegativity –they should be able to define this and understand that it determines bond polarity. Give them (or ask them to research) electronegativity values for elements in the Periodic Table and investigate trends down groups and across periods. (They should also be able to observe and compare patterns of electronegativity with other aspects previously dealt with, such as atomic radius and ionisation energy.) These values could be used to determine the degree of polarity in different bonds in terms of being full ionic, polar covalent or non-polar. Learners should be able to illustrate polar bonds/dipoles, with the correct partial charges clearly shown on the respective atoms making up the bond. They should understand that the positive end of a dipole in one molecule can be attracted to the negative end of the same in another molecule. The dipole-dipole intermolecular forces can impact on the physical properties of the substance, particularly in terms of melting/boiling point. Learners could compare melting/boiling point values – for example, different types of halogenoalkane – and attribute this to the number and type of halogen atoms in the molecule.
- From this, the learners should come to understand that certain intermolecular interactions can result from induced temporary dipoles in non-polar molecules. There will have been some recognition that the electron density in atoms (and bonds) is not necessarily static and can result in areas of low and high electron density for a brief period. This is sufficient to induce temporary dipoles in adjacent molecules, resulting in intermolecular forces between the molecules (often referred to as London dispersion or sometimes van der Waals forces). Learners should understand that, as the molecular mass increases, their effects will be more pronounced. Again, they can research and compare the melting/boiling points of non-polar hydrocarbons to relate these to relative molecular mass. Learners should recognise that one of the most important types of intermolecular interactions is hydrogen bonding, which has implications not only for chemistry but also for life in general.
- They need to understand that this arises from a dipole-dipole interaction that involves an electronegative atom (mainly N, O and F) and a hydrogen atom which is bonded to one of these. Learners can illustrate hydrogen bonding, again showing the partial charges that result in the interactions between different molecules. There needs to be some exploration of the properties of water and the role played by hydrogen bonding – particularly why its

boiling point is much higher than those of other group VI hydrides despite its lower RMM, the lower density of ice than liquid water and its high energy of vaporisation.

- At some stage when covering learning aim B, there could be demonstration of and/or a practical activity which explores the properties of metallic, ionic and covalent substances. This could entail investigating electrical conductivity, melting point/boiling point, looking at micrographs of crystalline substances, observing the deflection of water flow by a charged amber rod, etc.

Learning aim C – Investigate how the properties of elements change in the Periodic Table and methods of extraction from compounds

- Learning aim C takes a much closer look at how the properties of elements change in the Periodic Table, and will involve more practical activity than the previous two learning aims. Guide learners to safely carry out observations involving the group 1, 2 and 7 elements, as well as some transition metals, and to appreciate the inertness of the group 0 elements. They will develop further understanding of reduction and oxidation and come to realise the importance of this in chemistry and indeed beyond. As for other learning aims, this could also be introduced through a quiz or other exercise which seeks to gauge the learners' knowledge and understanding to date and identify any gaps that may need to be addressed before starting on the further content.
- For C1, some of the key properties of the group 1 and 2 elements (alkali and alkaline earth metals) may have been investigated in the earlier learning aims but learners can take a closer look (e.g. through research) at how properties such as hardness, density, electrical conductivity, malleability, and melting and boiling points vary down and across the two groups. The practical activities should include reaction with water, oxygen, displacement reactions (e.g. Mg/Cu) and flame tests, as well as the solubility of sulphates and hydroxides. Learners can further research these reactions as well as others involving s block elements, and should be able to write balanced equations.
- For C2, as with the group 1 and 2 elements, some of the key properties of the halogens will have been investigated in the earlier learning aims but learners can again take a closer look (e.g. through research) at how properties such as colour, state of matter, density, solubility in water and organic solvents, and melting and boiling point differ within the group. The practical activities undertaken should include reactivity with metals, displacement reactions, reactivity with metal halides, tests for the halide ions using silver nitrate and ammonia, and concentrated acid solutions. Again, learners can further research these reactions as well as others involving the halogens, and should be able to write balanced equations.
- For C3, as with the other groups of elements, some of the key properties of the transition metals may (although perhaps to a lesser extent) have been investigated previously but learners can again take a closer look (e.g. through research) at physical and chemical properties, including tensile strength, hardness, density, melting and boiling points, catalysis, coloured compounds, formation of more than ion and formation of complex ions. There will probably be some scope for learners to observe (through participation and/or demonstration by you) reactivity with water, oxygen and dilute acids. As before, learners can further research these reactions as well as others involving the transition metals and should be able to write balanced equations for them.

- For C4, direct the learners to research the physical properties of the noble gases in terms of their density, melting and boiling points, and solubility (and how this varies as the group is descended). Learners will appreciate that, because of the full and stable valence shell, the noble gases are very inert and rarely take part in chemical reactions. Direct learners to research some of the reactions that the heavier noble gases can partake in and the products formed. They should particularly recognise that the two most electronegative elements can form compounds with noble gases from xenon down.
- For C5, use a number of examples from the reactions investigated above to explain reduction and oxidation (redox) and identify what elements are reduced and which are oxidised in the process. For example, learners could come to appreciate that, in the reaction of magnesium and oxygen, magnesium has gained oxygen but lost electrons, so is oxidised. In the reverse it loses oxygen and gains electrons, so is reduced. Learners could use the term 'OILRIG' to help define oxidation and reduction and understand that a reducing agent causes something to be reduced by giving it electrons, etc.
- You can then introduce the concept of oxidation number and teach the learners the rules for assigning them. Learners can then use the latter in worked examples to identify the oxidation number of elements such as N, S, P, Cl, etc. in a range of compounds and compound ions. Again, using some examples from the practical activities, they can begin to write half equations which represent both the reduction and oxidation in the reactions, noting the change of oxidation number of the elements involved.
- For C6, while the learners may have had some previous insight into the extraction of certain metals, you should direct them to research methods for obtaining the metals listed in the unit content. They should understand that, whatever the process of extraction, it involves the metal being reduced. They should realise that the lesser reactive elements can be extracted by displacement involving a more reactive element (e.g. blast furnace extraction from iron (III) oxide using carbon reduction or of titanium form titanium (IV) chloride by magnesium).
- The learners should also understand that more reactive elements such as the s block elements and chlorine will require electrolysis of molten compounds which contain them. Direct learners to carry out further research into the production methods in terms of the operating conditions, energy requirements, atom economy, environmental considerations etc., as well as to review the uses and applications of the extracted elements in terms of their properties.

Learning aim D – Be able to determine reacting quantities in chemical reactions

- Learning aim D is concerned with the determination of reacting quantities in chemical reactions. Learners should be aware that this is essential for chemical synthesis, e.g. to work out how much reactant is needed to produce a certain amount of a required product, and in quantitative analysis. At this stage they have been introduced to relative atomic mass and can use this to calculate relative formula/molecular masses in order to apply the mole concept to quantify actual masses of substances that can be used in chemical reactions. It will also be applied for determining the quantity of gases and concentration of solutions. The focus will then shift to analytical techniques whereby learners will use the skills developed in gravimetric and volumetric analysis. As for the other three learning aims, you can get learners to take a quiz to gauge their knowledge and understanding to date.

- It is envisaged that the initial teaching strategy of D1 will involve the use of a set of formulae which enables learners to convert mass to moles, convert moles to mass, determine the number of moles in a particular volume of gas at room temperature and determine the molarity of a solution containing a certain mass of solute in a certain volume of solution. Learners should be given adequate opportunity to practise calculations relating to this and they should be fully aware that the mole is a quantity which represents the number of particles in the molar mass of a substance (i.e. Avogadro's number). The focus can then shift to the learners working out reacting masses from the balanced stoichiometric equations. Although the learners will have had some practice in writing balanced equations from the reactions in learning aim C, further practice may be required.
- For D2, give learners the opportunity to use gravimetric techniques to determine the amount of analyte involving the oxidation of a metal, reduction of a metal oxide, and decomposition of a hydrogen carbonate or hydrated compound. It is important that learners use the equipment and materials safely and correctly, calibrating them and ensuring accurate transfer and mixing of solutions, precipitation, filtering, washing and drying the solid. Learners can further practise their skills, particularly with regard to the necessary calculations, by doing worked examples where the weights etc. have been supplied by you.
- Learners should now have the opportunity to use volumetric analysis to determine the concentration of a solution of unknown concentration. A standard solution of an acid or base should be prepared which can be used in a titration to standardise sodium hydroxide or hydrochloric acid respectively. Again, it is important that the equipment is used safely and correctly to prepare the standard solutions, calibrating the equipment (e.g. weighing scales and glassware), accurately transferring the solutions and carrying out titrations using the appropriate indicator. Learners should be aware of the need to take several titration readings to ensure maximum accuracy and consistency. Learners can again further practise their skills, particularly with regard to the necessary calculations, by doing worked examples where the titres, volumes etc. have been supplied by you.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit links to:

- *Unit 6: Principles and Applications of Chemistry II*
- *Unit 16: Applications of Inorganic Chemistry*
- *Unit 20: Applications of Physical Chemistry*
- *Unit 21: Applications of Organic Chemistry.*

It will also link to aspects of other specific qualifications in chemistry, particularly AS/A2 Chemistry.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC International L3 Qualifications in Applied Science. Check the Pearson website at: (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Annets, F – *Applied Science L3 BTEC National* (Pearson Education, 2010) ISBN 9781846906800. Chapter 1 supports understanding of atomic structure, bonding and quantitative chemistry, while Chapters 4 and 22 support an understanding of the practical and analytical skills needed.

Chapman, B, Beavon, R and Jarvis, A – *Structure, Bonding and Main Group Chemistry* (Nelson Thornes, 2003) ISBN 9780748776559. Good overview of the main features of the periodic table, groups, bonding and structure.

Clark, J – *Calculations in AS/A Level Chemistry* (Longman, 2000) ISBN 9780582411270. This book has many relevant calculations and worked examples.

Fullick, A and McDuell, B – *Edexcel AS Chemistry Students' Book*, 1st edition (Longman, 2008) ISBN 9781405896351. Various chapters support understanding of periodicity, group 1 and 7 properties and reactivity.

Ramsden, E N – *A-Level Chemistry*, 4th edition (Nelson Thornes, 2000) (ISBN 9780748752997. In-depth look at atomic theory, bonding and periodicity.

Ramsden, E – *Calculations for A-Level Chemistry* (Nelson Thornes, 2001) ISBN 9780748758399. This book has many relevant calculations and worked examples.

Journal

Chemistry World – go to the Royal Society of Chemistry website and search 'Chemistry world'.

Videos

Search ‘chemistry’ on YouTube. There is a wide range of videos available on this site which will cover most topics in the unit.

Websites

Visit the Chemistry LibreTexts website. This Open Access textbook environment supplants conventional paper-based books and has a wide-ranging collection of articles on most topics.

Visit the www.cleapss.org.uk website for health and safety information when handling chemicals and performing experiments.

Visit the National STEM (Science Technology Engineering and Mathematics) Centre website – resources for supporting delivery and learning, links with employers and industry.

Visit the Nuffield Foundation website for a good range of practical chemistry experiments.

Visit the Royal Society of Chemistry website for resources and videos to support the delivery of chemistry.

Visit the Association of Science Education website for links to resources, activities, events and research.

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