Unit 3: Skills and Techniques for Chemistry Investigations

Unit reference number: F/600/5941
QCF level: 1
Credit value: 4
Guided learning hours: 40

Unit aim

The aim of this unit is to develop learners' knowledge and understanding of some of the fundamental concepts in chemistry. Learners will also be able to prepare useful chemical products.

Unit introduction

In this unit learners will cover some of the fundamental topics in chemistry, including extraction of raw materials from the Earth and its atmosphere, classification, properties of materials, chemical reactions and the factors that affect chemical reactions.

It is also important that learners have knowledge of the applications of chemistry such as uses for sustainable development, waste disposal, and pollution, their effects on the environment and society.

Learners will develop skills in the safe handling of laboratory apparatus, observation and measurement. Learners will also develop the skills and techniques needed to follow laboratory procedures and processes safely, carry out risk analyses and use correct scientific symbols and terminology.

Essential resources

Learners will need access to a chemistry/science laboratory equipped with a fume cupboard and standard laboratory chemistry apparatus. Access to a range of information resources, including the internet, to complete investigative assignments and case studies will be essential.

Learning outcomes and assessment criteria

In order to pass this unit, the evidence that the learners present for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

On completion of this unit learners should:

Learning outcomes		Assessment criteria		Unit amplification
1	Understand how chemical elements are classified	1.1	identify elements 1 to 10 in the periodic table	*The periodic table*: elements; symbols; metals; non-metals; groups and periods *Atomic particles*: atoms; molecules and ions *Atomic structure*: electrons; protons and neutrons; electronic shells for the first 10 elements; relationship to the elements in groups 1, 7 and 8 and their properties
		1.2	classify elements 1 to 10 in the periodic table	
		1.3	compare simple ionic and covalent materials	*Bonding*: covalent and ionic materials, e.g. hydrogen, chlorine, carbon, methane, water, sodium chloride; properties of covalent and ionic materials
2	Know the main factors involved in chemical reactions	2.1	construct simple chemical equations	*Chemical changes*: starting material(s); chemical change; product(s), e.g. decomposition, neutralisation, dehydration and hydration, oxidation *Chemical equations*: word equations; simple balanced equations *Chemical products and useful properties*: types, e.g. acids, alkalis, fertilisers, baking powder, plastics, fireworks, sodium carbonate, cement, plaster, smart materials, nanochemicals
		2.2	describe the factors affecting chemical changes	*Factors involved in chemical changes*: e.g. concentration, temperature, catalyst, surface area; endothermic and exothermic reactions, increase and decrease in temperature, rates

Learning outcomes		Assessment criteria		Unit amplification
3	Know how to identify useful natural resources for use as potential future fuels	3.1	identify useful natural resources from the Earth and its atmosphere, and their applications	*Materials from natural resources*: e.g. oxygen, helium, oil, coal, natural gas, metal ore *Applications:* uses, e.g. construction, buildings, fuel, energy *Environmental and sustainable issues*: e.g. effects on the Earth's atmosphere, global warming, fossil fuels, disposal and recycling *Natural activity*: effects on the Earth's crust and its atmosphere from natural causes, e.g. volcanoes, earthquakes
		3.2	identify future fuels and their applications	*Future chemical fuels*: hydrogen; ethanol from biomass; fuel cells
4	Be able to create useful chemical products from given starting materials	4.1	create useful chemical products safely, following guidelines	*Chemical products*: e.g. soap, hand cream, glue, plastics, synthetic fibres *Health and safety*: risk assessment; personal and protective equipment; safety procedures; emergency procedures

Information for tutors

Delivery

The purpose of this unit is to develop learners' knowledge of some of the concepts underlying chemistry, along with the applications of chemistry to manufacturing and service industries. Delivery strategies should reflect the nature of work within the science sector by using an assignment/portfolio-building approach where learners take responsibility for their own learning and develop their practical investigative skills.

For learning outcome 1, learners need to understand the importance of the periodic table and the classification of chemical elements. Simple models can be used to show how molecules are represented. Models should also be used, wherever possible, to help demonstrate the properties of bonded substances.

In learning outcome 2, delivery needs to focus on learners' knowledge of the importance of types and patterns of chemical reactions producing new substances and altering the properties of new and existing substances.

Learning outcome 3 addresses the importance of extracting and using materials from the Earth and its atmosphere. It also addresses the environmental effects of using these materials, their disposal, recycling and sustainability. This is an important outcome where learners can discuss their own lifestyles and how they affect the environment and sustainable development.

Visiting speakers from the chemical industry or visits/placements to the industry would be useful to place concepts in a vocational setting.

Learners should be given the opportunity to carry out a number of formative developmental activities. Activities could include:

- using the periodic table to classify elements into groups, periods and metals/non-metals
- investigating the atomic structure of a selection of elements and their associated shells
- experiments to investigate the properties of simple covalent and ionic substances
- experiments to investigate chemical changes and the factors that affect them
- investigating useful chemical products and their relevant properties
- investigating the effects of human activity on the environment and sustainable development.

Learning outcome 4 gives learners the opportunity to create useful chemical products, whilst also demonstrating their ability to work safely in laboratory conditions.

Assessment

The centre will devise and mark the assessment for this unit.

Learners must meet all assessment criteria to pass the unit.

The assessment strategies used in this unit need to reflect the evidence requirements for the assessment criteria and should use scientific investigative assignments, where communication can be considered through the learners' presentations, scientific laboratory reports, posters, graphs, charts etc.

To achieve learning outcome 1, learners will need to present evidence showing that they can identify a number of elements, including gases, metals and how they are classified within the periodic table. This could be evidenced via an ICT-based presentation, or wall chart/poster presentation.

Learning outcome 2 focuses on how chemicals can react with each other, and the factors involved in generating or regulating these reactions. Assessment evidence could be generated through assessor observation of learners conducting simple experiments to investigate chemical changes and the factors that affect them, supported by question and answer sessions.

To achieve learning outcome 3, learners need to be able to identify natural resources and possible future fuels. Assessment evidence could be presented as reports, posters or leaflets.

Learning outcome 4 could be evidenced through observations of learners carrying out practical work. Learners should demonstrate their ability to create chemical products, following guidelines. They must also demonstrate their ability to work safely.

Suggested resources

Books

Goodfellow D, Hocking S and Musa I - *BTEC First Principles of Applied Science Student Book*, Pearson Education, 2012 (ISBN 9781446902790)

Hutchings K, Bertin I and Osborne C – *Classical Chemistry Experiments* (The Royal Society of Chemistry, 2000) ISBN 9780854049196

Levesley M, Johnson P, Jones M, Chapman C - *Edexcel GCSE Science: GCSE Science Student Book* (Pearson Education, 2011) ISBN 9781846908897

Ryan L – *Chemistry for You* (Nelson Thornes, 2001) ISBN 9780748762347

Sykit S – *Signs, Symbols and Systematics* (The ASE Companion to 5 - 16 Science, 2000) ISBN 9780863573125

Twenty First Century Science: *GCSE Chemistry Workbook* (OUP Oxford, 2011) ISBN 9780199138418

Websites

The Association for Science Education	www.ase.org.uk
BBC – GCSE Bitesize	www.bbc.co.uk/schools/gcsebitesize/science
Focus Educational Software Ltd	www.focuseducational.com
The Royal Society of Chemistry – Chemsoc	www.chemsoc.org
Sector Skills Council for Science, Engineering and Manufacturing Technologies	www.semta.org.uk