

Scheme of work – Cambridge IGCSE[®] Chemistry (US) 0439

Unit 10: Organic 2

Recommended prior knowledge

Students should have completed the units on Covalent Bonding and Organic 1.

Context

This unit builds on ideas from Units 7 & 8 and lays the foundations for Unit 11.

Outline

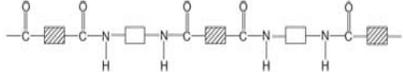
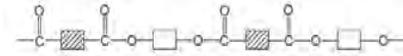
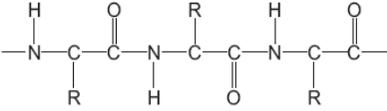
This unit follows on from Unit 8 and looks at the chemistry of the alcohols and carboxylic acids in more detail. A variety of synthetic and natural macromolecules are introduced together with their uses, as well as the environmental problems that they cause. Opportunity for students to research and discuss the pros and cons of using the different types of polymers. This unit is cross-referenced to assessment objectives A1–5, B1–5, C1–3 and Units 7 and 8.

(Please note: **(S)** in **bold** denotes material in the Supplement (Extended syllabus) only)

Syllabus ref	Learning objectives	Suggested teaching activities	Learning resources
14.7(S)	Describe the formation of ethanoic acid by the oxidation of ethanol by fermentation and with acidified potassium manganate(VII)	This can be shown by a simple test tube experiment or demonstration. Awareness of implications for storage of ethanol to prevent spoilage and the everyday use of the oxidation of ethanol in breathalysers. Extension to the purification by distillation [link to Unit 1] and the term 'reflux'.	www.practicalchemistry.org/experiments/oxidation-of-ethanol%2C239%2CEX.html
14.7	Describe the physical properties of aqueous ethanoic acid	Link to Unit 4 – Acids, bases and salts.	

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14.7(S)	Describe ethanoic acid as a typical weak acid	Students can illustrate this by: <ul style="list-style-type: none"> • Testing its pH with universal indicator; • Comparing the rate of reaction with magnesium with that of hydrochloric acid, a strong acid. 	
14.7(S)	Describe the reaction of ethanoic acid with ethanol to give an ester (ethyl ethanoate)	This can be shown by a simple test tube experiment. Students can be given samples of esters to smell. Risk Assessment! Awareness of importance of sweet-smelling esters as food and cosmetics additives.	www.chm.bris.ac.uk/motm/ethylacetate/smells.htm
14.8(S)	Describe macromolecules in terms of large molecules built up from small units (monomers), different macromolecules having different units and/or different linkages	Demonstrations of the preparation of poly(styrene) or poly(acrylates) are possible here. Link to Unit 8, importance of crude oil as a raw material for polymers and its finite supply.	Notes on addition polymers: www.docbrown.info/page04/OilProducts11.htm#synthetic
14.9(S)	Name some typical uses of plastics and of man-made fibres	Relate this to everyday items such as drinks containers, detergent bottles and other household items as well as clothes. Look at the underneath of bottles to determine the polymer and on clothing labels to find the fibre(s) used. Opportunity for display work about clothes, packaging (real packaging can be stuck to display) or building to show where polymers are used, their names, classification as synthetic or natural and diagrammatical representation of polymerisation. Extension – to investigate smart polymers (hydrogels-super absorbent polymers) in disposable nappies/diapers. Issues of disposal can be included.	Video clip on uses of polymers: www.bbc.co.uk/learningzone/clips/uses-of-polymers/1467.html

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14.9(S)	Describe the pollution problems caused by non-biodegradable plastics	<p>Students can look for polymers around the home using recycling information.</p> <p>Students can discuss the benefits and disadvantages of polymer production and research the steps taken by chemists to reduce the environmental impact. Students could prepare a presentation on impacts of polymers and benefits and constraints of recycling.</p> <p>Issues to discuss include:</p> <ul style="list-style-type: none"> • economic barriers to the collection, sorting and processing of waste for recycling • environmental effects of burning and landfill • centuries scale longevity of examples such as disposable nappies and packaging • students can carry out a survey to collect, classify and weigh a day's discarded plastic waste 	www.greenteacher.com/
14.9(S)	Deduce the structure of the polymer product from a given alkene and vice versa	<p>Opportunity to reinforce the importance of writing clear structural formulae here.</p> <p>Use models to illustrate addition polymerisation and images to allow identification of repeat units and monomers.</p> <p>Use kinaesthetic activity to illustrate the mechanism of polymerisation.</p>	www.bbc.co.uk/learningzone/clips/making-polythene-cracking-and-polymerisation/4427.html

Syllabus ref	Learning objectives	Suggested teaching activities	Learning resources
14.9(S)	<p>Describe the formation of nylon (a polyamide) and Terylene (a polyester) by condensation polymerisation, the structure of nylon being represented as:</p>  <p>and the structure of Terylene as:</p>  <p>(Details of manufacture and mechanisms of these polymerisations are not required.)</p>	<p>The formation of Nylon can be demonstrated by the reaction of a diacid chloride with a diamine (Nylon Rope Trick).</p> <p>This is a condensation reaction (addition/elimination reaction).</p> <p>Students can gently melt nylon granules on a tin lid and draw out a 'fishing line' using a glass rod.</p> <p>Emphasise the structure of both polymers (opposite). Students should be instructed to show the amide/ester bond clearly and draw two repeat units for each polymer in examinations.</p> <p>Opportunity to make models of each polymer.</p>	<p><i>Chemistry Experiments</i>, J. A. Hunt, A. Geoffrey Sykes, J. P. Mason, Longman 1996, Experiment 19.</p> <p>www.chemistry-videos.org.uk/chem%20clips/Nylon/nylon.html</p> <p>Video clip on nylon: www.rsc.org/Education/Teachers/Resources/Alchemy/</p>
14.9(S)	<p>Name proteins, fats and carbohydrates as the main constituents of food</p>	<p>Food packaging labels and 'healthy eating' claims on labels can be used as a source of discussion.</p>	<p>Extensive information about sugar: www.sucrose.com/</p>
14.9(S)	<p>Describe proteins as possessing the same (amide) linkages as nylon but with different units. Describe the structure of proteins as:</p> 	<p>Stress the amide (peptide) CONH group present linking the monomers together.</p> <p>Opportunity to make models of a section of a protein.</p>	

Syllabus ref	Learning objectives	Suggested teaching activities	Learning resources
14.9(S)	<p>Describe the hydrolysis of proteins to amino acids</p> <p>(Structures and names are not required.)</p>	<p>Opportunity to link to experimental use of locating agents in chromatography.</p> <p>Awareness of the use of this process as a diagnostic tool to identify when patients lack a particular amino acid.</p> <p>Stress the COO group present linking the monomers together.</p>	
14.9(S)	<p>Describe fats as esters possessing the same linkage as Terylene but with different units</p>	<p>Fats are esters of glycerol and long-chain carboxylic acids (fatty acids).</p>	<p>www.chemguide.co.uk/organicprops/esters/polyesters.html</p>
14.9(S)	<p>Describe soap as a product of hydrolysis of fats</p>	<p>Experiment/demonstration possible using common vegetable oils and concentrated sodium hydroxide solution to make soap.</p> <p>Issues for discussion include:</p> <ul style="list-style-type: none"> the changing social preference for using vegetable oil rather than animal fat (such as whale blubber) as a raw material the use of potential food crops as 'cash crop' sources of oil for soap. 	<p>www.soap-making.co.uk/1-25.html</p> <p><i>R. Norris & R. Stanbridge. Chemistry for IGCSE, Nelson Thornes, 2009, ISBN 9781408500187, p241 Fig. 20.2.3</i></p>
14.9(S)	<p>Describe complex carbohydrates in terms of a large number of sugar units, considered as $\text{HO}-\square-\text{OH}$, joined together by condensation polymerisation,</p> <p>e.g. $-\text{O}-\square-\text{O}-\square-\text{O}-\square-\text{O}-$</p>	<p>Link this with Cambridge IGCSE Biology.</p> <p>Awareness of the importance of photosynthesis as a means of producing a renewable energy resource</p> <p>Opportunity to make models of a section of a carbohydrate either made from the same sugar or different sugar units.</p>	
14.9(S)	<p>Describe the acid hydrolysis of complex carbohydrates (e.g. starch) to give simple sugars</p>	<p>Awareness of the importance of this reaction to the ability of animals to absorb food for energy as soluble sugar from ingested insoluble complex carbohydrate.</p>	

Syllabus ref	Learning objectives	Suggested teaching activities	Learning resources
14.9(S)	<p>Describe the fermentation of simple sugars to produce ethanol (and carbon dioxide)</p> <p>(Candidates will not be expected to give the molecular formulae of sugars.)</p>	<p>Experiment / demonstration of fermentation possibly combined with distillation to produce alcohol [link to Organic Chemistry 1 and Cambridge IGCSE Biology].</p> <p>Awareness of limitations on industrial conditions to increase the rate of this reaction due to living organism involved (yeast). Emphasise reaction stops when either the glucose is used up or the yeast is killed by the higher concentration of ethanol.</p> <p>Stress enzymes are not killed – they are denatured in the yeast.</p> <p>Compare the pros and cons of the different methods to produce ethanol (fermentation of sugar solution and hydration of ethane – link to Unit 8).</p> <p>Link to important potential of ethanol as a renewable fuel.</p>	<p><i>R. Norris & R. Stanbridge. Chemistry for IGCSE, Nelson Thornes, 2009, ISBN 9781408500187, p244 Fig. 20.4.1</i></p>
14.9(S)	<p>Describe, in outline, the usefulness of chromatography in separating and identifying the products of hydrolysis of carbohydrates and proteins</p>	<p>Experiments possible include the separation of a mixture of amino acids using ninhydrin as a locating agent [link to Unit 1].</p>	