UNIT 10 Organic Chemistry 2

Recommended Prior Knowledge This should be taught towards the end of the course. The unit assumes knowledge of units 1, 4 and 8 and that the students can write and balance equations.

Context The unit builds on previous learning about homologous series, alkanes, alkenes and covalent bonding. Carboxylic acids are examples of weak acids and so link to learning about acids in Unit 8. Th unit can be used to form a summary of the organic component of the course.
Outline Students study three main classes of organic compound; alcohols, carboxylic acids and condensation polymers. The level of the unit is accessible to most pupils if it is studied late in the course.

	Summary of learning Outcomes (see syllabus for full detail)	**Suggested Teaching Activities**	**Further teacher guidance**	**Online resources**
11.3 a b	**Alcohols** describe alcohols as a homologous series containing the OH group name and draw the structures of alcohols C1 to C4	Students can make flashcards of the names and formulae of the first four alcohols. These could be used in matching or ordering exercises or students can work in pairs to test each other. More able pupils can derive a general formula for the alcohols and use it to predict the formula of larger molecules. Students can use databooks or an online database to research the physical properties of the alcohols e.g. melting and boiling points. This information can be used to revise ideas about trends in homologous series first met in Unit 3.	Students may need to revise ideas about homologous series (Syllabus learning outcomes 11.1 and 11.2) first met in Unit 3. If modelling kits are available, students should build models of the alcohols. Models can also be built using cocktail sticks or drinking straws for bonds and modelling clay or sweets for atoms.	www.wpbschoolhouse.btinternet.co.uk/page10/page10.htm Click on 'Extra Organic Chemistry' This section contains information of relevance to the whole unit. www.wpbschoolhouse.btinternet.co.uk/page10/page10.htm Click on 'Compiled tables of data'
c	describe the properties of alcohols (combustion and oxidation to carboxylic acids)	This should be linked to exothermic changes (Unit 3, Syllabus learning outcome 5 (a) onwards). Students can compare the energy output of different alcohols by measuring temperature changes when water is heated using alcohol burners. Importance of ethanol (and methanol) as fuel for cars – reduction of CO pollution (renewable fuel – Brazil & New Zealand)	This is an opportunity to practise writing and balancing equations, and to revise the use of energy profile diagrams (Syllabus learning outcome 5 (b))	www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiments 79, 85.

D e	describe the formation of ethanol by the catalysed addition of steam to ethene and by the fermentation of glucose state some uses of ethanol (solvent, renewable fuel, alcoholic drinks	The fermentation of ethanol can be carried out on a test-tube scale. The mixture can be fractionally distilled to give ethanol that is pure enough to ignite – this illustrates in outline the production of ethanol for fuel (e.g. in Brazil). Contrast the flammability, or not, of brandy and wine. Students should know the equation and conditions for the industrial preparation of ethanol from ethene. Students can discuss the conditions by considering the choice of temperature, pressure and catalyst in terms of optimum yield and rate.	The distillation of ethanol made by fermentation can be used as an example of fractional distillation to illustrate Syllabus learning objective 1.2 (a) This is an opportunity to discuss the use of ethanol as a renewable fuel made from glucose obtained by photosynthesis (Syllabus learning objective 5 (j))	http://science.howstuffworks.com/winemaking.htm http://journeytoforever.org/ethanol.html
11.4 a b	**Carboxylic Acids** describe carboxylic acids as a homologous series containing the COOH group name and draw the structures of carboxylic acids C1 to C4	Similar activities to those used for the teaching of alcohols (above) can be used. More able students should use the concepts they have learned to predict trends in physical properties and formulae for unfamiliar homologous series e.g. the acyl chlorides.	Models of the molecules can be made, where materials are available (see alcohols, above).	http://www.spinaweb.ie/showcase/1124/index.htm
c	describe carboxylic acids as weak acids (reactions with carbonates, bases and metals)	Students can carry out the reactions on a test-tube scale. A worthwhile approach is to carry out experiments to compare the reactions to those of a typical strong mineral acid e.g. dilute hydrochloric acid. Students should identify any gases formed and write equations for the reactions.	This can be used to revise ideas about strong and weak acids met in unit 8 (Syllabus learning objective 7.1(d)) Students can revise gas tests for carbon dioxide and hydrogen.	www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiment 78.
d	describe the formation of ethanoic acid by the oxidation of ethanol by atomospheric oxygen and acidified potassium dichromate(VI)	Both reactions work on a test tube scale. A suggested experiment for air oxidation is to put the same volume of ethanol into vessels with different surface areas, and add a few drops of Universal Indicator solution to each. Students can monitor the pH change over several days as ethanoic	Redox should be discussed in terms of oxygen transfer and oxidation number. If available, a pH probe and data logger should be used to monitor the pH changes.	http://www.creative-chemistry.org.uk/alevel/module3/documents/N-ch3-15.pdf http://www.rjclarkson.demon.co.uk/junior/oxidethanol.htm

		acid forms. Air oxidation of wine to vinegar. Old-style 'breathalysers' where test crystals turn green are a useful illustration. The oxidation by potassium dichromate(VI) revises the test for a reducing agent (Syllabus learning objective 6.2(d))	This reaction can be discussed in terms of the conditions needed for long term storage of ethanol.	
e f	describe the reaction of ethanoic acid with ethanol to make an ester state some uses of esters (perfumes, flavourings, solvents)	The reaction can be carried out either by the students or as a demonstration. The students can be given the opportunity to note the characteristic smell of 'pear drops' to illustrate the use of esters in perfumes and flavourings.	If samples of other esters are available, students can smell them and decide whether they resemble fruit flavourings.	http://library.thinkquest.org/3659/orgchem/carboxylicacids.html click on 'visit site' when web page appears
11.5 e	**Macromolecules** describe the condensation polymerisation of nylon (polyamide) and *Terylene* (polyester) using representations as shown in the syllabus section 11.5(e)	The polymerisation of nylon from solutions of its monomers can be demonstrated – 'nylon rope experiment'. Students can melt nylon granules over a gentle heat on a metal lid or plate. A glass rod can be used to draw a thread from the melted nylon. This is a similar method to that used to make nylon threads for purposes such as fishing lines. Students should be able to draw the structures of polyesters and polyamides if they are given the formulae of the monomer molecules. They should also practise writing monomer formulae from diagrams of polymer structures. They need to be able to identify the repeating unit from a diagram of a length of polymer chain.	This section builds directly on the macromolecules section which dealt with addition polymerisation in Unit 4.	www.s-cool.co.uk/contents.asp click on 'GCSE revision' then 'Chemistry' then choose topic: 'products from crude oil' . Use the 'Quick learn' section.
f	state some typical uses of man-made fibres (clothing, curtain materials, fishing line, parachutes, sleeping bags)	Students can carry out a polymer survey by looking at the labels in their clothes or at the information in a clothing catalogue.	Students may be interested to know that *Terylene* is being replaced in coat and	www.psrc.usm.edu/macrog/index.htm

		They can survey the range of fibres used, and classify the fibres as man-made and synthetic.	sleeping bag packing by recycled polymers. Used plastic bags can be melted and spun into fibres that have similar properties to *Terylene*.	www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiments 10, 12.
g	describe the pollution problems caused by non-biodegradable plastics – comparison of addition and condensation polymers in this context.	Students should recognise that the non-biodegradable nature of many plastics leads to long term environmental problems. Issues to discuss include the need for conserving oil reserves and recycling of plastic waste. Biodegradable plastics have limited uses as they are usually weaker materials.	Some of these ideas were met in Unit 3, Syllabus learning objective 11 (b).	Recycling symbols: http://www.cswd.net/recycling/symbols.shtml
	identify carbohydrates, proteins and fats as natural macromolecules describe the similarities and differences between protein and nylon (same amide linkage, different monomer units – multiple monomers in the case of proteins & genetic control of sequence) describe the similarities and differences between fats and *Terylene* (same ester linkage, different monomer units)	The main ideas to address are to compare the structures of natural and man-made polymers in terms of the variability of monomers in the natural molecule. Students should be able to identify whether a macromolecule is a polyamide or polyester by looking at its structure.	Examples of structures of natural proteins can be found in Advanced level biology text books.	http://www.wpbschoolhouse.btinternet.co.uk/page04/OilProducts/ExtraOrganic.htm http://inventors.about.com/library/weekly/aa980325.htm http://www.owlnet.rice.edu/~chem121/lab/polymers/therms.html
	describe the hydrolysis of proteins and carbohydrates	This can be carried out as a demonstration. Students need to know the conditions for the hydrolysis and be able to predict the likely monomers that will form from a given polymer structure.	This technique is used as a diagnostic tool in medicine. The resulting amino acids are identified by analysing their Rf values by using chromatography and a locating agent (Syllabus learning outcome 1.2 (c)). Sugars can also be separated by paper chromatography and	

			‘visualised’ by drying in oven.	