UNIT 4 Atmosphere and Environment

Recommended Prior Knowledge Unit 1
Context The ideas covered in the unit are suitable to be studied early in the course.
Outline This unit studies the gases in the atmosphere, both naturally occurring and pollutant, and the role of chemistry in supplying drinking water. The unit 'stands alone' but can be used to introduce or practise skills from other syllabus areas including the use of symbols and equations, covalent bonding, Redox and acidic nature of non-metal oxides. The study of water purification can be used to practise separation techniques as preparation for the practical component of the examination. All pupils should find the ideas in this unit accessible.

	Summary of learning Outcomes (see syllabus for full detail)	**Suggested Teaching Activities**	**Further teacher guidance**	**Online resources**
10.1 a b c	**Air** Know the composition, separation and uses of the gases in air	Students can process the percentage composition data using bar graphs or pie charts or by using a spread sheet. This activity can be used to practise the mathematical requirements of the course (see Appendix 1 of the current syllabus). Students should be taught how fractional distillation works. This is a good opportunity for students to think about boiling points with negative values. Students can use text books, CD Roms and the internet to find out what the gases are used for.	Unit 3, Organic Chemistry, includes the teaching of covalent bonding. If students have already studied Unit 3, they can draw 'dot and cross' diagrams to represent the bonding in the atmospheric gases that have a simple structure. This cross-links to Syllabus Learning Outcome 1.2(a), purification by distillation. The BOC site gives useful information on the separation and uses of gases from the air.	Use a search engine such as 'Google' to search for uses of the gases in air. http://mistupid.com/chemistry/aircomp.htm www.boc.com/education/index.html www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiment 11
d, e g	Know the names and sources of atmospheric pollutants (CO; CH_4; NO_x; O_3; SO_2; hydrocarbons) Discuss the effects of pollutants on health (carbon monoxide and acid rain)	Suggested Research Activity: One approach is to ask different groups to research the different gases. Each group needs to be given specific tasks so that the key learning objectives are covered e.g. ask students to find out… • the formula of the gas • how it is formed as a pollutant • what problems it causes	This is an opportunity to refer to the idea of exothermic reactions again in preparation for Unit 6. This is also an opportunity to teach the gas tests for carbon dioxide, sulphur dioxide and oxygen (Syllabus learning outcome 1.3(c))	Many governments monitor air quality. Use a search engine to search for 'Air quality data/information' to find local information about levels of pollutants. http://www.epa.gov/ebtpages/air.html

		• how we can solve the problems or reduce the pollution Groups take turns to present their findings to the whole group e.g. using posters or by giving a talk supported by OHTs or a presentation using 'Powerpoint'. Resources to use include text books, CD roms and the internet. If this approach is followed, students will need to be presented with a summary of all the information and carry out some comprehension-type questions to ensure that all students consolidate information about all the gases.	Ideas about the acidity of non-metal oxides can be introduced here as preparation for Syllabus Learning Outcome 7.1(h) in Unit 8	www.airquality.co.uk/archive/index.php www.carbonmonoxidekills.com www.wpbschoolhouse.btinternet.co.uk/page10/page10.htm Click on 'Earth Science Notes' http://web.stclair.k12.il.us/splashd/acidexp.htm
f	Describe the reactions in catalytic converters and flue-gas desulphurisation	Students should use ideas about Redox reactions to explain the reactions in calalytic converters. At this early stage, the reactions can be discussed simply in terms of oxygen loss and gain. They also need to think about how the structure of the converters is linked to speeds of reaction. The reactions happen very fast due to the temperature and high surface area (This links to learning outcome 6.1). Flu-gas desulphurisation is an opportunity to consider some social and economic issues e.g. how industrial processes use large amounts of raw materials and can produce large amounts of waste for disposal.	This unit provides an opportunity to teach ideas about REDOX reactions in terms of oxygen gain – particularly in reference to the reactions in a catalytic converter, (Syllabus Learning Outcome 6.2(a)). Energy profile diagrams (Syllabus learning outcome 5(b) are taught in Unit 6. However, there is an opportunity to introduce these ideas here to represent the lowering of activation energy by the catalysts. Many governments set maximum levels of allowable	Go to www.howstuffworks.com and search for 'catalytic converter'

			exhaust emissions for pollutant gases. Local garages should be able to provide the school with a list of the maximum concentration of pollutant gases that are acceptable in exhaust emissions.	
h	Discuss the causes and effects of ozone depletion	Students should know the nature of CFCs. They need to know an outline of the problems of ozone depletion e.g. UV light levels may rise, this may cause skin cancer to humans and kill smaller organisms. If Unit 3 has already been covered, students can research names of CFCs and draw diagrams or make models of their structures. More able students can draw dot and cross representations of the simpler molecules.	This provides an opportunity to practise and consolidate Learning outcomes 2.5 (a) to (d) Covalent bonding.	http://svs.gsfc.nasa.gov/stories/index_2000.html www.howstuffworks.com search for 'refrigerators'
i j	Describe the carbon cycle (combustion, respiration and photosynthesis) Discuss the causes and effects of global warming – referring to the 'greenhouse gases', carbon dioxide and methane.	Students should use flow charts to show the processes occurring in the carbon cycle. They should know equations for the processes and appreciate that combustion of fossil fuels is causing a rise in atmospheric concentration of carbon dioxide. A suggested extension is to discuss the approaches that governments and scientists are using to reduce the amount of carbon dioxide that is being released.	Refer to the sources of CO_2 and CH_4 . Also mention other factors, such as deforestation, that impact on the problem.	http://globalwarming.enviroweb.org www.kids.infoplease.lycos.com click on 'science' 'environment' 'photosynthesis' www.defra.gov.uk/environment/climatechange/schools www.wpbschoolhouse.btinternet.co.uk/page10/page10.htm Click on 'Earth Science Notes'

				http://www.purchon.com/chemistry/flash/cycle.swf
10.2 a	**Water** State what dissolved substances are in water, both naturally occurring and pollutant.	Students can evaporated measured volumes of different types of water (e.g. sea, river, tap, bottled) and estimate the dissolved mass per litre. Labels from bottled water can be analysed. Students can process the data using bar charts or tables and compare water composition from different sources.	This is an opportunity to remind students about the formulae, names and charges of common ions.	www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiment 42 www.wpbschoolhouse.btinternet.co.uk/page10/page10.htm Click on 'Extra Aqueous Chemistry'
b	Discuss the environmental effects of dissolved substances (beneficial and pollutant)	Students should know about the importance of the solubility of oxygen and mineral salts for aquatic life. Students should know about the main stages in eutrophication. This is a further opportunity to present a process using a flow chart. It is important to emphasise the chemical processes (solubility of salts and leaching) rather than the biological processes involved.	This links to the high solubility of ionic compounds in Groups 1 and 2, first discussed in Unit 2	www.wpbschoolhouse.btinternet.co.uk/page10/page10.htm Click on 'Reversible Reactions' for information on eutrophication.
c, d	Outline water purification processes (filtration, use of carbon, chlorination, desalination)	Suggested experiment: Students can set up their own water filtration column using bands of successively smaller gravel and sand. They can test its effectiveness compared to conventional filter paper by filtering a mixture of soil and water and evaporating a measured sample of the filtrate. It is not expected that students should know any technical details of the processes		http://www.crocodile-clips.com/absorb/AC4/m3.htm go to 'Water' in 'samples' and click on 'view unit' Use Google image search for 'desalination' to see images of both membrane and distillation processes

		of desalination. However, an interesting approach would be to look at a membrane and distillation process in outline. Students can discuss the economic and environmental reasons for the adoption of the membrane process by many countries.		www.water.city.hiroshima.jp/english/methods.html
1.3 d	Describe a chemical test for water	Students can carry out a water test on a test-tube scale.		www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiment 109