

IGCSE Co-ordinated Sciences 0654

Unit 3: Gas exchange and respiration

Recommended Prior Knowledge

Students should have a basic understanding of cell structure, the human transport system and energy transfer. An understanding of the relationship between pressure and volume will help extension students to explain how breathing movements cause air to move into and out of the lungs.

Context

This Unit covers Topics B5 and B7. There are links to be made with P5 Energy transfer, with C14 Fuels, and with B17 Cycles and effects of organisms on the environment.

Outline

The Unit begins with a look at the human breathing system, where the relationship between structure and function is emphasised. Students then learn about the release of energy from glucose by respiration, and compare aerobic and anaerobic respiration.

Topic	Learning outcomes	Suggested Teaching activities	Learning resources
B5	Know the structure of the mammalian breathing system (larynx, trachea, epiglottis, bronchi, bronchioles, alveoli, pleural membranes, diaphragm and intercostal muscles). Understand how the structure of the alveoli and blood capillaries enable gaseous exchange to occur and the importance of diffusion in gaseous exchange across the alveoli Understand how movements of the intercostal muscles and diaphragm	If possible, show students lungs and their associated organs obtained from a butcher. Extension students can use a 'balloons in a bell jar' model to illustrate the effects of contraction of	The lungs – an overview of how they work http://http://www.lungnet.org <i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, pages 47–48 <i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, pages 48–49 http://www.mdhs.unimelb.edu Animation showing the structure of the lungs and the movement of oxygen from alveoli into red blood cells <i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, pages 49–50

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	enable inhalation and exhalation to occur through changes in pressure in the thorax.	the diaphragm on the volume of the lungs. They should relate this to their work on pressure and volume in P2.	http://www.bbc.co.uk/schools/ks3bitesize Short but very clear animation showing breathing movements. <i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G, page 47 http://www.bioscope.org Short animation showing how the movement of cilia moves debris up through the trachea. <i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G, pages 52–53
	Understand the role of goblet cells and cilia in keeping the lungs clear of infection.		
	Understand the effects of smoke and air pollution on the breathing system.		
	Be able to discuss the effects of cigarette smoke on health and the reasons why people smoke.	Extension students can research the effects of different components of tobacco on the goblet cells, ciliated cells, alveoli, red blood cells and blood vessels. They can analyse data that indicate the link between smoking and lung cancer or heart attacks.	Emphysema http://http://www.lungusa.org
	Know that air breathed out contains more carbon dioxide and less oxygen than air breathed in.	Students can investigate the difference in the carbon dioxide concentration between inspired and expired air using lime water or bicarbonate indicator solution. The oxygen concentration can be compared by timing the burning of a candle in a gas jar.	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G, pages 50–51
	Be able to state the percentage composition of inspired and expired air and to explain the reasons for the differences.		
B7	Understand that aerobic respiration involves transferring energy from glucose to a cell; oxygen is needed	A burning nut or other food (for example a piece of dry bread) held under a boiling tube of water can be used to measure the energy released	Introduction to respiration http://wow.nrri.umn.edu

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	and carbon dioxide produced. Appreciate that respiration occurs in all living cells.	when the food is oxidised. Quantitative comparisons between the energy released from different foods can be made. Links should be made with P6 (transferring energy by heating) and C14 (combustion of fuels). Students can compare respiration with combustion of fuels. Ensure that students understand the differences between 'respiration', 'breathing' and 'gas exchange', and understand that respiration takes place in every living cell, including plant cells. You could use living seeds (for example peas or beans) to demonstrate that they release carbon dioxide or heat energy, which indicates that they are respiring.	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G, page 44 http://www.saburchill.com Simple protocol for an experiment to investigate the production of carbon dioxide by germinating seeds http://www.saburchill.com Another simple protocol, this time to show heat production by germinating seeds.
	Be able to state the word equation for respiration	Students should think about the relationship between the equations for photosynthesis and respiration, and to understand how each of them relates to energy transfers.	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G, page 44
	Appreciate the uses of transferred energy to organisms (e.g. movement, growth and warming the body).	Ask students to draw energy transfer diagrams (make links with P5) showing how energy in food is transferred to muscle movement or heat production. In P5, they learn that when energy is transferred, some is lost as heat to the environment, and they can apply this principle to energy transfer in living things.	
	Understand that anaerobic respiration can occur in human muscles and that lactic acid is produced and must later be removed with the use of oxygen.	Students can measure their heart rate or breathing rate before, during and after doing exercise. They can relate the increase during exercise to the need for extra oxygen for aerobic respiration, and the time taken for breathing rate	<i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G, page 45–46 <i>Teaching and Assessing Practical Skills in Science</i> , CUP, Hayward D, pages 52–53

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		and heart rate to return to normal to the need to break down the lactic acid that was formed as a result of an insufficient oxygen supply to muscles. You could extend this investigation by comparing the time taken for breathing rate or heart rate to return to normal in students who regularly do sports with those who are less active and fit.	