

IGCSE Co-ordinated Sciences 0654

Unit 2: Photosynthesis, gas exchange and transport

Recommended Prior Knowledge

Students will need an understanding of cell structure, and the concepts of energy transfer.

Context

This Unit covers Topics B4 and B6. There are links to be made between B4 and P5 Energy transfer, and with C4 Chemicals from plants. Transport in both animals and plants is covered in B6, which develops concepts dealt with in B2 Cellular organisation and function.

Outline

This Unit first looks at the way in which photosynthesis transfers energy from sunlight into energy in chemical substances. Some of the substances made as a result of photosynthesis are considered, and there are obvious and very close links here with C4 Chemicals from plants. The Unit then moves on to look at how gases are exchanged in mammals, and comparisons can be made between the structures of leaves and lungs and their adaptations for gas exchange. Respiration will not be covered until Unit 3. Transport in both animals and plants is covered in B6, where links should be made back to B2 Cellular organisation and function, where the uptake of water into root hairs was dealt with.

Topic	Learning outcomes	Suggested Teaching activities	Learning resources
B4	<p>Understand the significance of photosynthesis in making food.</p> <p>Appreciate that photosynthesis transfers energy from sunlight into energy in chemicals such as glucose and starch.</p>	<p>Students can think of plants as 'food factories' in which all the food in the world is made, using raw materials that they get from the air and soil, and an energy source.</p>	<p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, page 34</p>

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	Understand the significance of chlorophyll as a light-absorbing molecule.		
	Know the word equation for photosynthesis.	Students can carry out practical work to investigate the need for light, chlorophyll and carbon dioxide in order for a leaf to make starch. They can use pond weed to investigate the production of oxygen.	Online Simple photosynthesis experiments. http://www.eduref.org
	Be able to perform starch tests on leaves.		Investigating the behaviour of leaf discs; a slightly different way of investigating the production of starch during photosynthesis: http://www.saps.plantsci.cam.ac.uk <i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G, page 40 <i>Teaching and Assessing Practical Skills in Science</i> , CUP, Hayward D, page 36
	Appreciate the variety of factors that limit the rate of photosynthesis and ways of overcoming the limitations when growing plants for food or other uses.	Extension students can investigate the effect of light intensity on the rate of photosynthesis, using water weed and a lamp placed at varying distances from it. Count bubbles per minute, or collect the gas and measure volume. They should be able to explain the shape of their graph in terms of limiting factors.	Online Various teacher and student resources on photosynthesis (register to use site) http://www.riverdeep.net <i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G, pages 40–42 <i>Teaching and Assessing Practical Skills in Science</i> , CUP. Hayward D, pages 71–72
	Appreciate how the structure of a leaf enables photosynthesis to occur effectively.	Provide students with a range of leaves, micrographs and microscope slides of transverse sections through leaves. Ask	Photomicrograph of <i>Eleagnus</i> leaf TS with vascular bundle: http://images.botany.org/set-13/13-063v.jpg <i>Biology for IGCSE and O Level</i> , CUP, Jones M and Jones G, pages 35–36

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		<p>groups to make a list of features they think will help with photosynthesis and why; draw together a class list of these features. They can build on the idea of the leaf as a food factory, considering how the raw materials and energy supply are provided to it, and how the products are stored or taken away.</p> <p>Drawings of leaves, including calculation of magnification, and a comparison between them, make good practice or assessment materials for Assessment Objective C2.</p>	
	<p>Understand how photosynthesis affects the concentrations of carbon dioxide and oxygen in water or the atmosphere.</p>	<p>Use bicarbonate indicator solution to investigate the effect of plants, animals separately and together, in light and in darkness, on the concentration of carbon dioxide in a small, closed container.</p>	
	<p>Understand that plants need nitrate ions for making proteins and that they may absorb these from the soil.</p>	<p>Section C4 develops ideas about the molecular structure of carbohydrates and proteins, including the presence of N in amino acids and proteins. This will be further developed in later work on the nitrogen cycle and fertilisers.</p>	<p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, page 39</p>

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B6	<p>Know that plants take up water and inorganic ions through root hairs.</p> <p>Know that xylem transports water and inorganic ions and that phloem transports the products of photosynthesis.</p> <p>Know that transpiration provides a 'pull' which draws water through xylem vessels.</p> <p>Understand how environmental conditions may alter the transpiration rate and thus the rate of water uptake by a</p>	<p>Large and semi-transparent stalks, such as the leaf petioles of celery, can be placed with the bases in a solution of a water-soluble dye. Students can trace the passage of the dye up the stem, and then cut transverse sections to see the positions of the xylem vessels containing the dye.</p> <p>Simple potometers can be made from a long, straight glass tube (preferably capillary tubing) with a short length of tightly-fitting rubber tubing at one end into which the end of a cut shoot can be fixed. Keep everything under water while assembling, to avoid air bubbles.</p> <p>Extension students can investigate the effects of factors such as wind and temperature on the rate of uptake of water, which is related to the rate of transpiration.</p>	<p>Online Diagrams and descriptions of root structures: http://www.ffp/sciro.au/research/mycorrhiza/root.html</p> <p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, pages 65–66</p> <p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, pages 65–66 and 70</p> <p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, pages 67–70</p> <p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, pages 68–69</p> <p>http://www.phschool.com Some short and simple animations and quizzes on transpiration, plus some data to collect and record in a 'virtual experiment' on the effect of various factors on the rate of transpiration.</p>

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	<p>plant. Understand that arteries carry blood away from the heart, veins carry blood towards the heart and capillaries link arteries with veins and are the sites of exchange with the tissues.</p>	<p>Students should look at transverse sections through arteries and veins, preferably using microscope slides, and pick out features which allow them to identify them.</p>	<p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, pages 57–59 http://library.thinkquest.org Animation showing movement of blood through the circulatory system.</p>
	<p>Be able to relate the structure of arteries, veins and capillaries to their functions.</p>	<p>Extension students can build up a table summarising the differences in structure of these three types of blood vessel, and an explanation of how these differences are related to their functions.</p>	<p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, pages 57–59 http://www3.umdj.edu Micrographs of arteries and veins. http://www.bbc.co.uk/schools/gcsebitesize/biology/humansasorganisms/1circulationrev3.shtml Simple, clear description of structure of blood vessels related to their functions.</p>
	<p>Know the external and internal structure of the mammalian heart, and understand its function.</p>	<p>If possible, show students a real heart obtained from a butcher. A simple dissection will show the four chambers, the differences in thickness between the walls of the left and right sides, and between the atria and ventricles; the valves; and the main vessels entering and leaving the heart.</p>	<p>Structure of the heart: http://www.wehealnewyork.org/services/cardiology/structure.html Animation of heartbeat: http://web.ukonline.co.uk/webwise/spinneret/ciculn/ancad.htm http://www.bbc.co.uk/schools/gcsebitesize/biology/humansasorganisms/1circulationrev2.shtml Heart structure and function. <i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, pages 54–57</p>

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	<p>Be able to explain the events leading to a heart attack and a stroke and appreciate how life-style may affect the risk of heart attacks or strokes.</p>		<p>http://www.nhsdirect.nhs.uk/articles/article.aspx?articleId=187 NHS direct site about heart attacks, including causes, symptoms and ways of reducing risk.</p>
	<p>Know that red blood cells carry oxygen, attached to haemoglobin, around the body of a mammal know that white blood cells prevent infection becoming established know that platelets help in clotting and that plasma transports glucose, carbon dioxide, hormones and urea.</p>	<p>Students could be given a large copy of a micrograph of blood, and annotate it to summarise the functions of each part...</p>	<p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, pages 59–62 http://health.howstuffworks.com/adam-200028.htm Animation showing how and where red blood cells are produced, and the composition of blood.</p>
	<p>Appreciate the roles of phagocytes and antibodies in destroying invading microorganisms.</p>	<p>Extension students should have a simple understanding of how blood helps to defend the body against disease.</p>	<p><i>Biology for IGCSE and O Level</i>, CUP, Jones M and Jones G, pages 139–140 http://health.howstuffworks.com/adam-200096.htm Short animation showing phagocytosis.</p>