CAMBRIDGE International Examinations

Activity 4

Extract from the learner guide

Topic	Sub-topic	You should be able to:	Checklist	Comments
13 Photosynthesis	**13.1 Photosynthesis as an energy transfer process** Light energy absorbed by chloroplast pigments in the light dependent stage of photosynthesis is used to drive reactions of the light independent stage that produce complex organic compounds. Chromatography is used to identify chloroplast pigments and was also used to identify the intermediates in the Calvin cycle.	a) explain that energy transferred as ATP and reduced NADP from the light dependent stage is used during the light independent stage (Calvin cycle) of photosynthesis to produce complex organic molecules b) state the sites of the light dependent and the light independent stages in the chloroplast c) describe the role of chloroplast pigments (chlorophyll a, chlorophyll b, carotene and xanthophyll) in light absorption in the grana d) interpret absorption and action spectra of chloroplast pigments e) use chromatography to separate and identify chloroplast pigments and carry out an investigation to compare the chloroplast pigments in different plants (reference should be made to R_f values in identification) f) describe the light dependent stage as the photoactivation of chlorophyll resulting in the photolysis of water and the transfer of energy to ATP and reduced NADP (cyclic and non-cyclic photophosphorylation should be described in outline only) g) outline the three main stages of the Calvin cycle: • fixation of carbon dioxide by combination with ribulose bisphosphate (RuBP), a 5C compound, to yield two molecules of GP (PGA), a 3C compound • the reduction of GP to triose phosphate (TP) involving ATP and reduced NADP • the regeneration of ribulose bisphosphate (RuBP) using ATP h) describe, in outline, the conversion of Calvin cycle intermediates to carbohydrates, lipids and amino acids and their uses in the plant cell		

A Level material				
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13 Photosynthesis	**13.2 Investigation of limiting factors** Environmental factors influence the rate of photosynthesis. Investigating these shows how they can be managed in protected environments used in crop production.	a) explain the term limiting factor in relation to photosynthesis b) explain the effects of changes in light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis c) explain how an understanding of limiting factors is used to increase crop yields in protected environments, such as glasshouses d) carry out an investigation to determine the effect of light intensity or light wavelength on the rate of photosynthesis using a redox indicator (e.g. DCPIP) and a suspension of chloroplasts (the Hill reaction) e) carry out investigations on the effects of light intensity, carbon dioxide and temperature on the rate of photosynthesis using whole plants, e.g. aquatic plants such as *Elodea* and *Cabomba*		
13 Photosynthesis	**13.3 Adaptations for photosynthesis** All the stages of photosynthesis occur in the chloroplast. Some tropical crops have C4 metabolism and adaptations to maximise carbon dioxide fixation.	a) describe the relationship between structure and function in the chloroplast using diagrams and electron micrographs b) explain how the anatomy and physiology of the leaves of C4 plants, such as maize or sorghum, are adapted for high rates of carbon fixation at high temperatures in terms of: • the spatial separation of initial carbon fixation from the light dependent stage (biochemical details of the C4 pathway are required in outline only) • the high optimum temperatures of the enzymes involved		