

OCR (B) Biology A-level

Topic 4.3 - Photosynthesis, Food Production and Populations

Definitions and Concepts

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4.3.1 Photosynthesis, food production and management of the environment

Abiotic factors - The non-living aspects of an ecosystem, e.g. light, temperature, water availability, oxygen availability and soil pH.

Accessory photosynthetic pigment - A pigment which absorbs wavelengths of light that the primary pigment cannot.

Adenosine triphosphate (ATP) - A nucleotide derivative consisting of a molecule of ribose joined to the nitrogenous base adenine and three phosphate groups. It acts as the main energy currency in cells.

ATP synthase - An enzyme found embedded in cellular membranes that phosphorylates ADP to form ATP as protons flow through it.

Azotobacter - A type of nitrogen-fixing bacteria that lives freely in the soil.

Biodiversity - The variety of living organisms in an ecosystem.

Biomass - The total mass of organic material, measured in a specific area over a set time period. This can be calculated in terms of dry mass.

Biosensor - A biological molecule is paired with a device that generates a thermal, optical or electrical signal when a specific reaction takes place in order to detect the presence of a particular chemical.

Biotic factors - The living components of an ecosystem e.g. food availability, pathogens, predators and other species.

Calvin cycle - See 'Light-independent reaction'.

Carotenes - A group of photosynthetic carotenoid pigments which absorb blue, violet and ultraviolet wavelengths of light, and reflect orange and red wavelengths of light.

Carrying capacity - The maximum population size that can be indefinitely supported by an environment.

Cellulose - A linear polysaccharide that is the main component of the cell wall in plants and is made up of many beta glucose molecules joined by β -1,4 glycosidic bonds.

Chlorophyll a - The main photosynthetic pigment. It absorbs orange-red and violet-blue wavelengths of light, and reflects green-yellow light.

Chlorophyll b - An accessory photosynthetic pigment which can absorb a higher frequency of blue light than chlorophyll a.

Chloroplast - An organelle found in plants and algae that is the site of photosynthesis.

Climax community - The stable community of organisms that exists at the final stage of ecological succession.



Compensation point - The light intensity at which the rate of photosynthesis equals the rate of respiration.

Countryside stewardship scheme (CSS) - A scheme in England (1991-2014) that aimed to provide financial incentives to farmers to enhance and conserve the environment. Replaced by the Environmental Stewardship Scheme (ESS).

DCPIP - An artificial hydrogen acceptor that changes colour from dark blue to colourless when reduced.

Deflected succession - Changes to the natural flow of succession due to human activity that result in a stable community known as a plagioclimax.

Denitrification - The conversion of nitrate ions to nitrogen gas by denitrifying bacteria.

Denitrifying bacteria - Anaerobic microorganisms, found in waterlogged soils, responsible for the reduction of nitrate ions to nitrogen gas.

Electron transport chain - A series of electron carrier proteins that transfer electrons in a chain of oxidation-reduction reactions.

Extensive farming - For a large area of crop land, a relatively low amount of labour and fertilizer is used.

Glycerate-3-phosphate (GP) - A three-carbon molecule that is reduced by reduced NADP in the light-independent stage of photosynthesis to form two molecules of TP. This requires ATP.

Hedgerow - An area of shrubs or trees marking the boundary of crop land which acts as a significant source of biodiversity.

Hill Reaction - During the light-dependent reaction of photosynthesis, the transfer of electrons due to photoionisation can be observed using a redox indicator.

Hydrogencarbonate indicator - An indicator which changes colour depending on the concentration of carbon dioxide and the resulting pH of the solution.

Intensive farming - For a small area of crop land, a large amount of labour and fertiliser is used. This method has high yield per metre squared.

Lamellae - Membranous channels that connect adjacent grana in a chloroplast.

Light-dependent reaction - The first stage of photosynthesis that uses light energy to produce ATP, reduced NADP and oxygen. It takes place in the thylakoids of the chloroplast.

Light harvesting complex - A collection of protein and chlorophyll molecules found in the thylakoid membranes of chloroplasts that absorbs light energy of varying wavelengths and transfers it to the reaction centre. It is also known as an antennae complex.



Light-independent reaction - The second stage of photosynthesis, also known as the Calvin cycle, in which the products of the light-dependent stage and carbon dioxide are used to build organic molecules. It does not require light energy and takes place in the stroma.

NADP - A coenzyme that becomes reduced when it takes up hydrogen atoms during the light-dependent stage of photosynthesis, forming reduced NADP.

Nitrates - An anion with the group NO_3^- .

Nitrobacter - A genus of nitrifying bacteria that oxidises nitrites into nitrates.

Nitrogen cycle - The cycle through which nitrogen moves between living organisms and the environment, involving ammonification, nitrification, nitrogen fixation and denitrification.

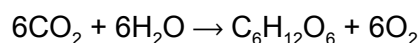
Nitrogen fixation - The conversion of atmospheric nitrogen gas into ammonia by nitrogen-fixing bacteria in the soil or root nodules of legumes.

Nitrogen fixing bacteria - Microorganisms responsible for the conversion of atmospheric nitrogen gas into nitrogen-containing compounds. They can be free-living or mutualistic.

Nitrosomonas - A genus of nitrifying bacteria that oxidises ammonium compounds into nitrites.

Paper chromatography - A technique used to separate different molecules in a solution by their relative affinities for the paper and a solvent.

Photosynthesis - A complex metabolic pathway that synthesises organic molecules in the presence of light. It consists of three main stages: capturing of light energy, light-dependent reaction, light-independent reaction. Overall:



Photosynthetic pigments - Molecules present in chloroplasts that absorb certain wavelengths of light, e.g. chlorophyll a, chlorophyll b, xanthophylls and carotenoids.

Photosystem - A protein complex consisting of a light-harvesting system and reaction centre, that is involved in the absorption of light and transfer of electrons in photosynthesis.

Plagioclimax - A stage in succession in which artificial factors prevent the formation of a natural climax community.

Primary succession - A type of succession in which pioneer species colonise a newly formed or exposed area of land.

Random sampling - A sampling technique used to avoid bias, e.g. creating a square grid and generating random coordinates.

Rhizobium - A type of nitrogen-fixing bacteria that lives inside the root nodules of leguminous plants.



Ribulose biphosphate (RuBP) - A five-carbon compound that reacts with carbon dioxide in the light-independent stage of photosynthesis, forming two molecules of GP.

Ribulose biphosphate carboxylase (RuBisCO) - An enzyme that catalyses the reaction of RuBP and carbon dioxide in the light-independent stage of photosynthesis.

Ruminants - Mammals that ferment plant-based foods in their specialised stomachs which have four compartments: the rumen, reticulum, omasum and abomasum. Microbes in the rumen digest cellulose, and produce volatile fatty acids and amino acids.

Stroma - The fluid interior of chloroplasts that contains the enzymes required for the light-independent reaction.

Succession - Describes changes in the community of organisms occupying a certain area over time.

Sulfates - An anion with the group SO_4^{2-} .

Systematic sampling - A type of non-random sampling in which samples are taken from different regions of a habitat.

Thylakoids - A series of flattened membrane-bound compartments in chloroplasts. They are stacked to form grana and contain the chlorophyll and other molecules needed for the light-dependent reaction.

Triose phosphate (TP) - A three-carbon compound formed in glycolysis and the light-independent stage of photosynthesis. It may serve as a starting material for the formation of organic molecules or be used to regenerate RuBP.

4.3.2 The impact of population increase

Abiotic factors - The non-living aspects of an ecosystem, e.g. light, temperature, water availability, oxygen availability and soil pH.

Biotic factors - The living components of an ecosystem e.g. food availability, pathogens, predators and other species.

Birth rate - The number of offspring born per thousand of population per year.

Cereal - Any grass cultivated for edible grains.

Death rate - The number of deaths per thousand of population per year.

Emergency Prevention System (EMPRES) - A system established by the United Nations Food and Agriculture Organisation in 2009 to ensure food safety by identifying potential issues in the food supply chain and coordinating a response via the International Food Safety Authorities Network (INFOSAN).



Food Chain Crisis Management Framework (FCC) - A response framework used by the United Nations Food and Agriculture Organisation to respond to emergencies in the food chain, such as the outbreak of a pest which threatens crops. It operates through the Intelligence and Coordination Unit, EMPRES and the Response Unit.

Food security - A measure of how much food is available for people to access. It includes considerations of affordability.

Food sustainability - Food production and consumption that conserves resources and contributes to economic growth in local communities.

Simpson's Diversity Index (D) - A measurement of diversity that considers both species richness and evenness. Calculated using the formula:

$$D = 1 - \sum \left(\frac{n}{N}\right)^2$$

United Nations Food and Agriculture Organisation - A specialised United Nations agency which aims to achieve global food security.

