

Edexcel IAL Biology A-level

Topic 5: Energy Flow, Ecosystems and the Environment

Definitions and Concepts

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5.1-5.8: Photosynthesis

Absorption spectrum: The absorption spectrum indicates the wavelengths of light *absorbed* by each pigment (e.g. chlorophyll).

Action spectrum: The action spectrum indicates the overall rate of photosynthesis at each wavelength of light.

Adenosine diphosphate (ADP): A nucleotide composed of adenosine and two phosphate groups that is formed in living cells as an intermediate between ATP and AMP. It is converted into ATP by the addition of a high-energy phosphate group.

Adenosine triphosphate (ATP): A molecule that acts as the energy currency of cells formed from a molecule of ribose, a molecule of adenine and three phosphate groups.

Calvin cycle: The group of light-independent reactions involved in photosynthesis.

Carbon fixation (Calvin cycle): The addition of CO_2 to RUBP to form an unstable 6 carbon intermediate in the Calvin cycle catalysed by RuBisCO.

Chlorophyll: The main photosynthetic pigment found in chloroplasts which is used to capture energy from photons during photosynthesis.

Chloroplast: An organelle found in plants and algae which is the site of photosynthesis.

Chromatography - The process of separating different substances from a mixture.

Glyceraldehyde-3-phosphate (GALP): The 3-carbon molecule produced by the reduction of GP by NADPH using the energy provided by the hydrolysis of ATP.

Glycerate 3-phosphate (GP): The 3-carbon molecule produced by the spontaneous breakdown of the 6-carbon product of carbon fixation.

Granum: A stack of thylakoids.

Hydrolysis: A chemical reaction in which a water molecule is used to split polymers into monomers.

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 system: 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.

Limiting factor: A variable that limits the rate of a particular reaction.

Nicotinamide adenine dinucleotide phosphate (NADP): A cofactor used in anabolic reactions, such as the Calvin cycle and lipid and nucleic acid synthesis, which require NADPH as a reducing agent.

Photolysis: The breaking apart of a molecule using light.

Photophosphorylation: The addition of a phosphate group onto a molecule using the energy obtained from sunlight.

Photosynthesis: The process of harnessing the energy from sunlight to split apart the bonds in water molecules and store the hydrogen in organic molecules by combining it with carbon dioxide.

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

Retention factor/ Rf value (chromatography): The distance traveled by a migrating compound divided by the distance traveled by the solvent.

Ribulose biphosphate (RuBP): A 5-carbon compound involved in the Calvin cycle, which combines with atmospheric CO₂ to form a 6 carbon compound, with the help of an enzyme (biological catalyst) called RuBisCo.

RuBisCO: The enzyme used to fix carbon dioxide in the Calvin cycle.

Thylakoids: Flattened membrane-bound sacs found inside chloroplasts which are the site of the light-dependent reactions of photosynthesis.

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.

5.9-5.14: Ecosystems and Biomass

Abiotic factor: A non-living physical or chemical factor that affects an organism, for instance, pH and light intensity.

Belt transect: A line along a sampled area upon which quadrats are placed at intervals to determine the abundance and distribution of organisms in an ecosystem.



Biomass transfer efficiency: The proportion of energy transferred between biomass levels, calculated using the following equation:

$$\text{Biomass transfer efficiency} = \frac{\text{Biomass at higher level}}{\text{Biomass at lower level}} \times 100$$

Biomass: The dry mass of all of the living organisms in an area.

Biotic factor: A living factor that affects an organism, for instance predation and diseases.

Community: All the organisms of all species living in the same place at the same time.

Habitat: The place where an organism lives characterised by physical abiotic factors and the other organisms living there.

Ecosystem: A relatively self-contained unit consisting of all the organisms living in a place including the abiotic and biotic factors.

Gross primary productivity (GPP): The total amount of energy fixed as chemical energy during photosynthesis carried out by producers.

Habitat biodiversity: A measure of the number of different habitats found within an area.

Line transect: A line along a sampled area. The species touching the transect at regular intervals are recorded to determine the abundance and distribution of organisms in an ecosystem.

Net primary productivity (NPP): The amount of chemical energy that is available for transfer once the amount of energy loss from respiration is deducted from the total amount of energy - calculated by the following equation:

$$\text{Net primary productivity} = \text{Gross primary productivity} - \text{Energy loss due to respiration}$$

Niche: An organism's role in the ecosystem, including the abiotic and biotic factors required for its survival.

Population: A group of organisms of the same species living in the same place at the same time.

Quadrat: A square grid of a known area used in sampling to determine the abundance of organisms in a habitat. There are two types: point quadrats and frame quadrats.

Trophic level: The position that an organism holds in a food chain, food web, pyramid of numbers or pyramid of biomass.



5.15-5.26 - Changes to Populations and the Environment

Allopatric speciation: A form of speciation that occurs when two populations become geographically isolated.

Anthropogenic climate change: Changes in the climate that are caused by human activity.

Behavioural isolation: The reproductive isolation of two populations due to differences in their behaviour, e.g. different mating rituals.

Biofuels: Fuels produced using biomass.

Carbon cycle: The cycle through which carbon (in the form of carbon dioxide) moves between living organisms and the environment, involving respiration, photosynthesis and combustion.

Carbon sinks: Reservoirs where carbon is removed from the atmosphere and 'locked up' in organic or inorganic compounds.

Causation: When a change in one variable influences another variable.

Climax community: A community that remains stable and shows little change over time.

Conservation: The maintenance of ecosystems and biodiversity by humans in order to preserve the Earth's resources. This typically involves the management of succession.

Correlation: When two data sets show the same trend.

Data extrapolation: The process of predicting unknown data using trends in known data sets which has many applications such as predicting changes in the climate.

Dendrochronology: The use of tree rings to work out data about the tree and its environment which can be useful for analysing changes in climate conditions.

Evolution: The gradual change in the allele frequencies within a population over time. Occurs due to random gene mutation and natural selection.

Gene mutation: A spontaneous change to at least one nucleotide base in DNA or the arrangement of bases. Gene mutations can occur spontaneously during DNA replication and may be beneficial, damaging, or neutral.

Gene pool: All of the different versions of genes (alleles) in the individuals that make up a population.

Global warming: A gradual increase in the average temperature of the Earth's atmosphere and surface.

Greenhouse gas: A gas that absorbs infrared radiation (net heat energy) emitted from



Earth's surface and reradiates it back to Earth's surface, thus contributing to the greenhouse effect.

Isolation: A process by which two species that could otherwise produce hybrid offspring are prevented from doing so. Isolation reduces gene flow between populations, leading to allopatric or sympatric speciation.

Morphological isolation: The reproductive isolation of two populations due to the incompatibility of their reproductive systems.

Natural selection: The process by which the frequency of 'advantageous' alleles gradually increases in a population's gene pool over time.

Optimum temperature (enzymes): The temperature at which enzyme activity is greatest. If the temperature increases beyond this point the enzyme starts to denature and the reaction rate falls.

Primary succession: The colonisation of previously uninhabited land by a pioneer species.

Q10: A temperature coefficient which is a measure of the rate of change of a biological system that occurs when the temperature changes by 10°C.

Reforestation: Replanting trees to replenish forests that have been destroyed.

Reproductive isolation: The inability of two populations of the same species to interbreed due to behavioural, morphological or seasonal barriers.

Seasonal isolation: The reproductive isolation of two populations due to differences in their breeding seasons.

Secondary succession: The re-colonisation of a habitat after a disturbance.

Speciation: The process by which new species arise after a population becomes reproductively or geographically isolated and cannot interbreed.

Succession: A directional change in a community over time.

Sustainable resources: Resources which can be continually renewed and used without being depleted.

Sympatric speciation: A form of speciation that occurs when two populations within the same area become reproductively isolated.

The greenhouse effect: The increase of global temperatures caused by the trapping of solar heat by gases in the atmosphere.

