

CAIE Biology A-level

Topic 12 - Energy and Respiration

Definitions and Concepts

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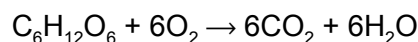


Acetyl coenzyme A - A two-carbon molecule formed in the link reaction when an acetyl group is bound by coenzyme A. It is oxidised in the Krebs cycle.

Adenosine triphosphate (ATP) - The universal energy carrier found in all living cells.

Aerenchyma - Spongy tissue with air spaces that allow gas exchange between the shoots and the roots of some plants e.g. rice.

Aerobic respiration - A form of cellular respiration that takes place in the presence of oxygen and produces carbon dioxide, water and ATP. Overall:



Anabolic reactions - Smaller molecules react to form larger molecules. This requires an energy input.

Anaerobic respiration - A form of cellular respiration that takes place in the absence of oxygen. It produces less ATP than aerobic respiration.

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

Chemiosmosis - The synthesis of ATP through the movement of protons down their concentration gradient across a semipermeable membrane, catalysed by ATP synthase.

Citrate - A six-carbon molecule formed in the first stage of the Krebs cycle from the reaction of acetyl coenzyme A and oxaloacetate.

Coenzyme - A molecule that helps enzymes carry out their function e.g. NAD, FAD, coenzyme A.

Coenzyme A - A coenzyme that binds an acetyl group to form acetyl coenzyme A during the link reaction of aerobic respiration.

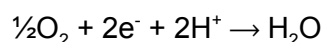
Cristae - Folds of the inner mitochondrial membrane that provide a large surface area for oxidative phosphorylation.

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

Decarboxylation - The removal of a carbon dioxide molecule.

Dehydrogenation - The removal of a hydrogen atom.

Electron acceptor - Oxygen acts as the final electron acceptor in the electron transfer chain:



Electron carriers - Protein molecules that accept and release electrons e.g. NAD.



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

FAD - A coenzyme that becomes reduced when it takes up hydrogen atoms during the Krebs cycle, forming reduced FAD.

Fructose 1,6-bisphosphate - A six-carbon molecule formed by the phosphorylation of glucose during glycolysis. It splits into two molecules of triose phosphate.

Glucose - A six-carbon monosaccharide which is an important respiratory substrate.

Glycolysis - An anaerobic process that takes place in the cytosol of the cell and breaks down glucose into two molecules of pyruvate. Two molecules of ATP and two molecules of reduced NAD are also formed.

Inner mitochondrial membrane - The mitochondrial membrane that separates the matrix from the intermembrane space. It is the site of the electron transport chain.

Intermembrane space - The small space between the inner and outer mitochondrial membranes. The electron transport chain results in a high proton concentration here.

Krebs cycle - A series of oxidation-reduction reactions in the matrix of the mitochondria in which acetyl coenzyme A is oxidised, generating reduced NAD, reduced FAD, ATP and carbon dioxide.

Lactate dehydrogenase - An enzyme that catalyses the conversion of pyruvate to lactate.

Link reaction - The first stage of aerobic respiration (also known as oxidative decarboxylation). It takes place in the mitochondrial matrix and converts pyruvate into acetyl coenzyme A and carbon dioxide. Reduced NAD is also formed. Overall:



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

Mitochondrial matrix - The fluid-filled space within the inner membrane of the mitochondria which contains mitochondrial DNA and enzymes required for aerobic respiration.

Mitochondrion - An organelle found in eukaryotic cells that is the site of aerobic respiration.

NAD - A coenzyme that becomes reduced when it takes up hydrogen atoms during aerobic respiration, forming reduced NAD.

Outer mitochondrial membrane - The membrane segregating the contents of the mitochondrion from the rest of the cell. It creates optimal conditions for aerobic respiration.

Oxaloacetate - A four-carbon molecule that combines with acetyl coenzyme A to produce six-carbon citrate in the first stage of the Krebs cycle. It is eventually regenerated, allowing the cycle to continue.



Oxidative phosphorylation - The synthesis of ATP from reduced coenzymes and oxygen in the electron transport chain of aerobic respiration.

Oxygen debt - The amount of additional oxygen required after a burst of anaerobic respiration to restore the body to a resting state.

Pyruvate - A three-carbon molecule produced in glycolysis. In the link reaction of aerobic respiration, it is oxidised to acetate. During fermentation, it is converted to lactate (animals) or ethanol and carbon dioxide (plants and microorganisms).

Redox indicator - A substance which changes colour when it gains or loses electrons.

Respiratory quotient - The ratio of carbon dioxide produced to oxygen consumed during respiration. Calculated using:

$$RQ = \frac{\text{CO}_2 \text{ produced}}{\text{O}_2 \text{ consumed}}$$

Respiratory substrate - An organic molecule that can be broken down via the respiratory pathways to produce ATP.

Respirometer - A device used to determine respiration rate in living organisms by measuring the change in volume of oxygen or carbon dioxide.

Substrate-level phosphorylation - The synthesis of ATP by the transfer of a phosphate group from a phosphorylated intermediate to ADP.

Triose phosphate - A three-carbon compound formed in glycolysis.

