

Chapter 9 Cellular Respiration: Harvesting Chemical Energy

Catabolic Pathways

Anaerobic pathways

Fermentation

Aerobic pathways

Cellular respiration

Organic compound + Oxygen → Carbon dioxide + Water + Energy

Redox reaction - reduction-oxidation reaction, a reaction with a transfer of electrons from one reactant to another (Fig 9.3)

Reducing agent – an electron donor

Oxidizing agent – an electron acceptor

NAD⁺ - nicotinamide adenine dinucleotide - oxidizing agent in cellular respiration (Fig 9.4)

Electron Transport Chain (Fig 9.5)

Stages of Respiration

Glycolysis - glucose to pyruvate (cytosol)

Krebs cycle - pyruvate to carbon dioxide (mitochondrial matrix)

Electron transport and oxidative phosphorylation - synthesis of ATP by use of redox reactions (mitochondrial inner membrane)

Substrate-level phosphorylation - ATP synthesis by transferring a phosphate group from a substrate to ADP. (Fig 9.7)

Glycolysis (Animation)

Energy investment phase - first 5 steps (Fig 9.9)

Energy payoff phase – last 5 steps (Fig 9.8)

Glycolysis to the Krebs Cycle (Fig 9.10)

Pyruvate's carboxyl group is removed and given off as CO₂

The remaining 2 carbon fragment is oxidized to acetate + NADH

Coenzyme A is attached to the acetate by an unstable bond

Krebs Cycle ([Animation](#), [Fig 9.11 & 9.12](#))

Krebs Cycle Review

Junction - 2 3-carbon compounds to 2 2-carbon compounds, 2 NADH, and 2 CO₂

6 NADH, 2ATP, 2FADH₂, 4CO₂

Electron Transport Chain ([Fig 9.13 & Animation](#))

ETC Terms

Cytochromes - electron carrying proteins

ATP synthase – the enzyme that makes ATP ([Fig 9.14](#))

Proton-motive force - The H⁺ gradient that results from the electron transport chain which powers the synthesis of ATP

Electron Transport Review

NADH and FADH₂ donate electrons to chain

H⁺ was pumped from the matrix to the intermembrane space

H⁺ was used to generate ~34 ATP

Cellular Respiration Review ([Fig 9.16](#))

Related Metabolic Processes

Alcohol fermentation ([Fig 9.17a](#))

Lactic Acid Fermentation ([Fig 9.17b](#))

Aerobic vs Anaerobic

Facilitative anaerobes - organisms that can survive by either fermentation or respiration

38 ATP vs 2 ATP

The catabolism of various food molecules ([Fig 9.19](#))

Beta oxidation - breaks down fatty acids into two carbon fragments, which enter the Krebs cycle as acetyl-CoA