Ch. 7: Cellular Respiration

Catabolic pathways yield energy by oxidizing organic fuels:

Fermentation - A partial deflation of sugar or other organic fuel that occurs without the use of oxygen.

Aerobic Respiration - The most efficient catabolic pathway in which oxygen is consumed as a reactant along with organic fuel.

Cellular Respiration - The complex aerobic process of breaking down glucose.

Redox Reactions - The partial or total shift of electrons from one substance to another.

Oxidation - Loss of electrons.

Reduction - Addition of electrons.

NAD+ (Nicotinamide Adenine Dinucleotide) - A coenzyme that is well suited as an electron carrier because it can cycle from its oxidized form (NAD+) to its reduced form (NADH).

Electron Transport Chain (ETC) - Consists of a number of molecules; mostly proteins, built into the inner membrane of the mitochondria of Eukaryotes & plasma membrane aerobic prokaryotes.

In cellular respiration most electrons move "downhill" by glucose → NADH → ETC → Oxygen.

Glycolysis - A process occurring in the cytosol that begins the degration process by breaking glucose into two molecules called pyruvate.

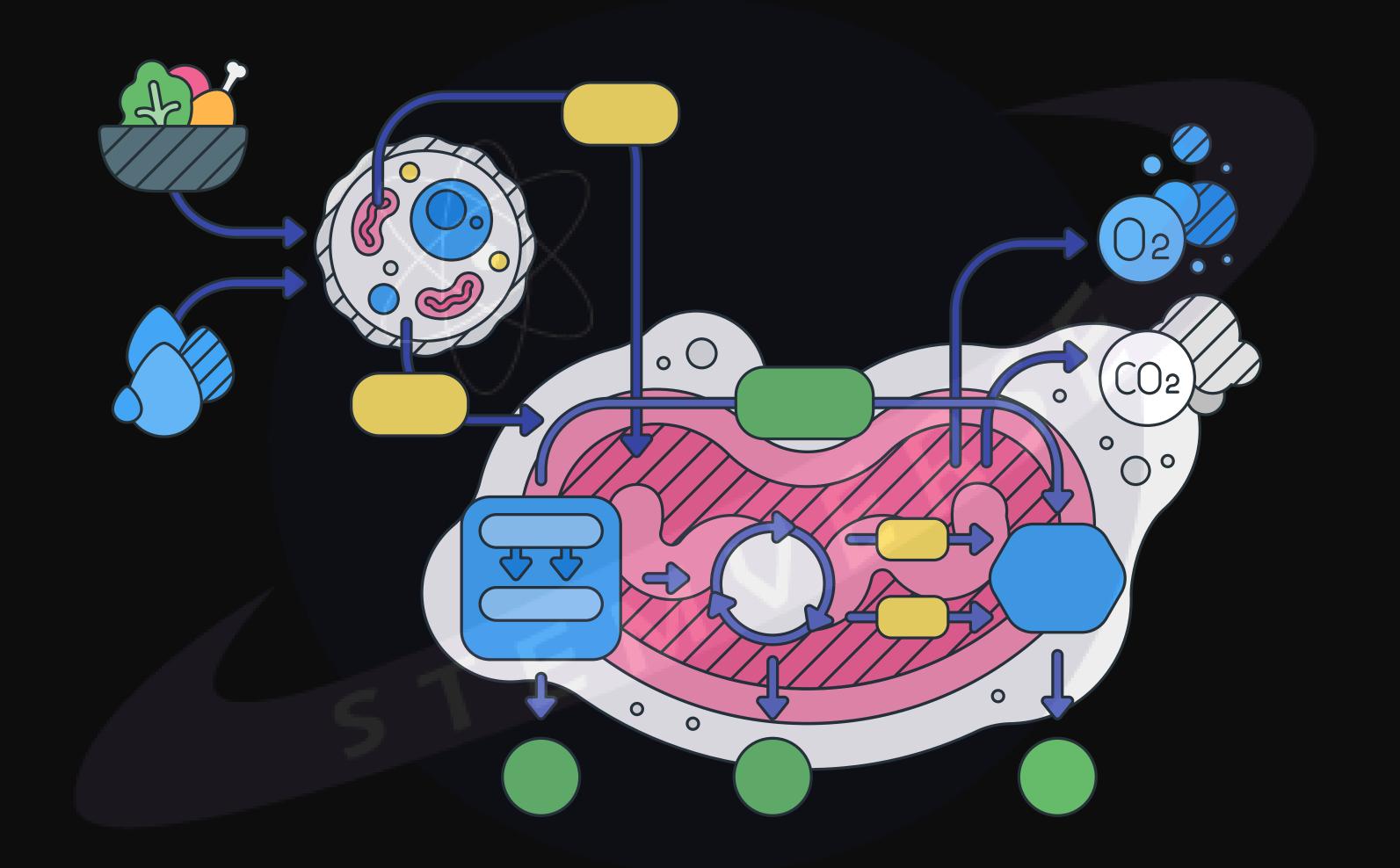
3 Stages of Aerobic Respiration

- 1) Glycolysis
- 2) Pyruvate processing (oxidation) + Citric acid cycle
- 3) Oxidative phosphorylation (ETC & Chemiosmosis)

Citric Acid Cycle - The breakdown of glucose to carbon dioxide is completed.

Oxidative Phosphorylation - The mode of ATP synthesis that is powered by redox reactions of the ETC.

Substrate-Level Phosphorylation - The mode of ATP synthesis that occurs when an enzyme transfers a phosphate group from a substrate molecules to ADP.



After pyruvate is oxidized, the citric acid cycle completes the energy-yielding oxidation of organic molecules:

Acetyl CoA - A highly reactive compound that feeds it acetyl group into the citric acid cycle.



During oxidative phosphorylation, chemiosmosis couples electron transport to ATP synthesis:

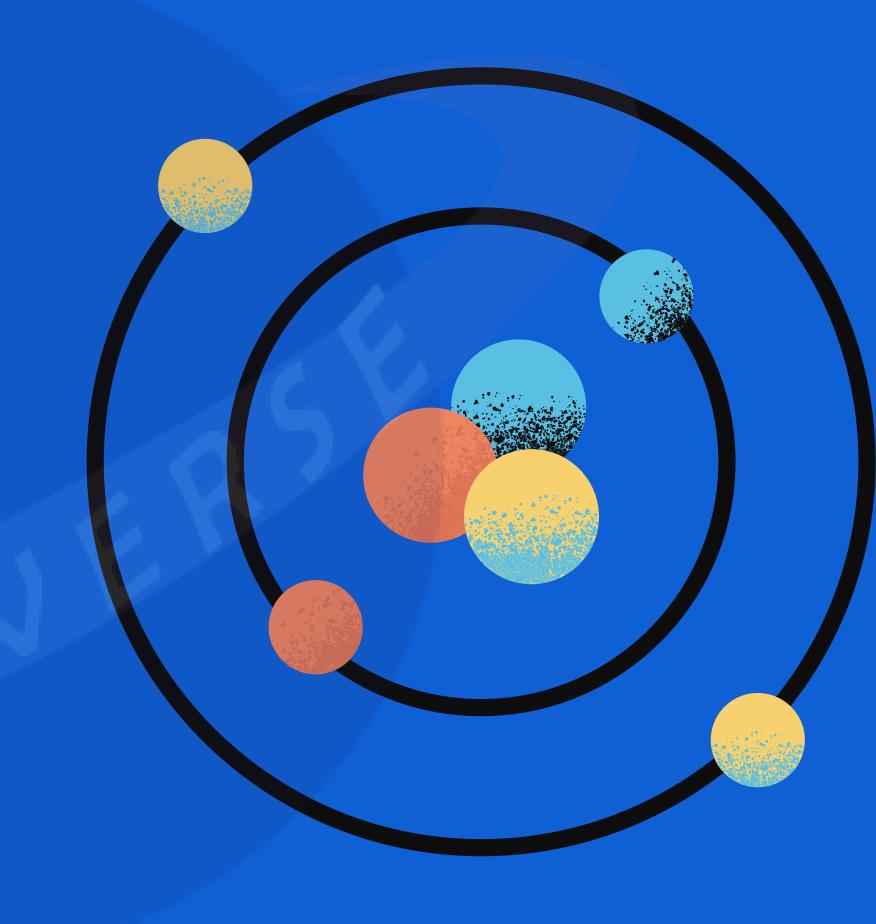
Cytochromes - The remaining electron carriers between ubiquinone (CoQ) and oxygen (proteins).

ATP - Synthase - The enzyme that makes ATP from ADP and inorganic phosphate.

Chemiosomosis - The process in which energy stored in the form of a hydrogen ion gradient across a membrane is used to drive cellular work (synthesis of ATP)

Ex. is the Proton-motive force (H+ gradient).

Electrons move from glucose \longrightarrow NADH \longrightarrow ETC \longrightarrow proton-motive force \longrightarrow ATP



Fermentation and anaerobic respiration enables cells to produce ATP without the use of oxygen:

Fermentation is a way of harvesting chemical energy without using either oxygen or any electron transport chain.

Alcohol Fermentation - Pyruvate is converted to ethanol (ethyl alcohol) in 2 steps.

Lactic Acid Fermentation - Pyruvate is reduced directly by NADH to form lactate as an end product with no release of CO2.

Obligate Anaerobes - Carry out only fermentation or anaerobic respiration.

Facultative Anaerobes - Organisms including yeast and bacteria that make enough ATP to survive using either fermentation or respiration.

Beta Oxidation - Breaks the fatty acids down to two-carbon fragments, which enter the citric acid cycle as Acetyl CoA.