Biology: Cellular Metabolism Cheat Sheet
by Kayla (Education Help23) via cheatography.com/201049/cs/42522/

Terms - Alphabetical

Active Transport:

Movement of molecules against a concentration gradient through a membrane protein and with input of energy.

Aerobic Respiration:

Production of ATP **with** oxygen

Anaerobic Respiration:

Production of ATP **without** oxygen

ADP (Adenosine diphospha)

Molecule consisting of one adenine, one sugar, and two phosphates.

Cellular Respiration:

Process of oxidizing food molecules and Reducing NAD1 molecules to produce ATP in various steps

Overview of Cellular Respiration

4 Macromolecules:

Proteins, Carbs, Lipids, Nucleic acid

ATP Energy:

ATP - Adenosine Triphosphate
Primary energy molecule in all cells
Formed by breaking carbon - hydrogen bonds

Redox Reactions:

Oxidation: loss of electrons
Reduction: gain electrons

Aerobic Respiration:

Requires oxygen and glucose to make ATP

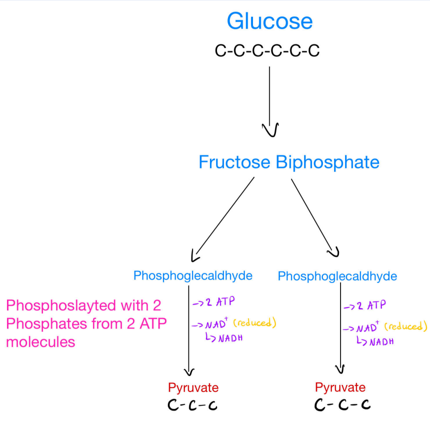
During cellular respiration, electrons and hydrogen Ions are moved from one molecule to another.

Stage 1 of Aerobic Cellular Respiration

Glycolysis

- Inside cytoplasm
- Anaerobic
- Glucose converted into pyruvate -> Breaks one glucose molcule (six carbons) into two pyruvate molecules (3 carbons).
- NAD^+ reduced -> NADH
- 2 ATP produced to start the process
- NADH are used by electron transport chain to produce a lot more ATP molecules

Glycolysis

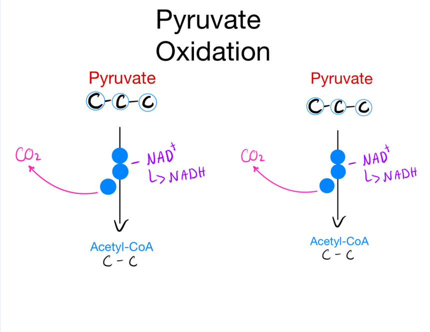


Stage 1.5 of Aerobic Cellular Respiration

Pyruvate Oxidation

- Electrons and hydrogen ions moving from pyruvate to the electron acceptor NAD^+ to produce more NADH molecules
- A carbon atom is removed from each pyruvate, leaving a 2 carbon molecule to combine with coenzyme A.
- The final product is acetyl-Coenzyme A **(acetyl-CoA)**
- The removed Carbon merges with oxygen making CO2

Pyruvate Oxidation



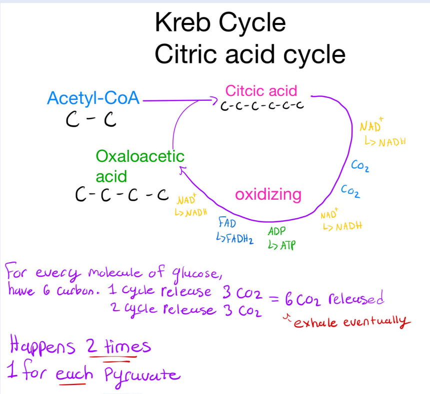
Stage 2 of Aerobic Cellular Respiration

Krebs Cycle - Citric Acid Cycle

- Occurs in matrix of mitochondria
- Aerobic - In this case, does not use up oxygen
- Acetyl-CoA (2 carbons) -> Oxaloacetic acid (4 carbons) = Citric acid (6 carbons)
- During the cycle carbon is removed to produce CO2, electrons and hydrogen ions are transferred to NAD+ and FAD forming NADH and FADH2.
- This leaves overall 6 NADH, 2 ATP, 2 FADH2

The cycle happens **2 times**, 1 time for each pyruvate.

Kreb Cycle for 1 Pyruvate



Importance of NADH and FADH2

• NAD+ and FAD are coenzymes that, when changed into NADH and FADH2, supply the electrons and hydrogen ions needed for the electron transport chain.
• Proton pumps are proteins in the membrane that transport hydrogen ions across it.
• These proton pumps are found in the cristae, the inner part of the mitochondrial membrane. They move hydrogen ions from inside the mitochondria to the space between the inner and outer membranes, creating a concentration gradient.
• The high concentration of hydrogen ions in this space is vital because it stores energy that is used to produce ATP.
• Due to the tendency of molecules to reach equilibrium, the hydrogen ions in the intermembrane space naturally want to move back into the matrix of the mitochondria. ATP synthase is the protein that allows this movement to occur.
• Chemiosmosis is the process where a chemical gradient (H+ ions) is used to generate ATP molecules by passing through ATP synthase, which converts ADP into ATP.

Electron Movement through Membrane Proteins

• As NADH and FADH2 release their hydrogen ions (H+) into the intermembrane space, their electrons pass through membrane proteins.
• The transfer of H+ ions into the intermembrane space is powered by active transport, with the energy sourced from the movement of electrons through the electron transport proteins.

Electrons at the end ofthe ETC

• Once carried by the membrane proteins, hydrogen ions and electrons must unite with oxygen.
• Without this union, they would accumulate in the mitochondria's matrix, causing electrons to react with other molecules and protons to create acidity.
• Oxygen serves as the ultimate electron acceptor in our cells. The electrons and protons (H+) that traverse the ETC and ATP synthase join with oxygen to create water molecules.

Electrons through the electron transport proteins

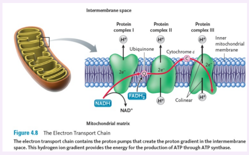


Figure 4.8 The Electron Transport Chain
The electron transport chain contains the proton pumps that create the proton gradient in the intermembrane space. This hydrogen ion gradient provides the energy for the production of ATP through ATP synthase.

Overview of ETC

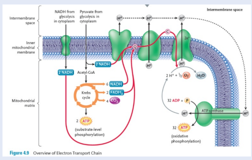


Figure 4.9 Overview of Electron Transport Chain

Fermentation

• Occurs in the cytoplasm
• Anaerobic - in the absence of oxygen organisms rely exclusively on • glycolysis to produce ATP
• NADH that is made during glycolysis must get rid of electrons to regenerate NAD^+
• With the recycling of NAD^+ glycolysis is allowed to continue

Fermentation Pt 2

In Yeasts (Single-celled fungi)

Pyruvate is converted into acetaldehyde, which then accepts hydrogen from the NADH, producing NAD^+ and **ethanol**
Used to produce foods such as wine, bread, tea, yogurt

In animals

• NADH gives electrons and hydrogen atom to pyruvate and becomes NAD^+
• NAD^+ can continue picking up electrons (recycling) so glycolysis can continue making 2 ATP
• Produces lactate (Lactic acid)
• Is important in humans for a burst of energy for a short time