Biology 10

Chapter 9-2
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"The Krebs Cycle and Electron Transport"

Objectives

- Describe what happens during the Krebs cycle.
- Explain how high energy electrons are used by the electron transport chain.
- Describe three pathways the body uses to release energy during exercise
- Compare photosynthesis and respiration.

The Krebs Cycle

- If oxygen is present (=________________________________), then the pyruvic acid formed in glycolysis enters the Krebs cycle
- There are two main parts to the Krebs cycle
  - formation of acetyl-coA
  - energy extraction phase (Citric Acid Cycle)

Acetyl CoA formation

- Pyruvate (3 carbon) has a carboxyl group removed (forming ______________)
- The remaining two carbon group is oxidized (forming ______________) and acetyl group
- The acetyl group is attached to coenzyme A, forming **acetyl coA**
- Products (for each original glucose): ____________________________________

  ____

Citric Acid Cycle (Kreb's Cycle)

- Acetyl CoA transfers the 2 carbon acetyl group to _________________ **oxaloacetate**
- this reaction forms a 6 carbon ________________ (citric acid) molecule
- Citrate loses 2 carboxyl groups (each forming ____________), and is oxidized twice (forming _________________)
  - these CO_2 molecules (and the ones from the formation of acetyl-coA) are what we exhale!

Citric Acid Cycle (Kreb's Cycle)

- For each acetyl CoA, an ______________ is then formed
- Eventually, the 4 carbon molecule remaining is oxidized twice more (forming _________________, and ____________________), and results in an oxaloacetate molecule, which is then ready for another acetyl coA!
- Products (for each glucose): ____________________________________

- for each acetyl coA, the numbers would be 2 CO_2, 1 ATP, 3 NADH, and 1 $FADH_2$

Energy Extraction Phase of Krebs Cycle

Electron Transport Chain

- All of the NADH and $FADH_2$ produced in the other steps enters the electron transport chain
- The hydrogen atoms are passed from one electron acceptor to another in a series of reactions, each of which releases a little bit of energy
- first electron acceptor is **flavin mononucleotide** (**FMN)**, some of the middle ones are ______________________ **(Q),** and **cytochromes,** the last is __________________
  - **so the role of oxygen in respiration is simply to be a ____________________**

  ____

  - When oxygen accepts the pair of electrons, it binds with two protons to form ____
- the energy released is used to separate the electron from the hydrogen and pass the remaining proton into the intermembrane space of the mitochondria
- this sets up a steep concentration gradient (protons more concentrated __________ the intermembrane space)

  the protons are only allowed back across the membrane through special protein molecules, which happen to be enzymes (__________________________**)** that phosphorylate ADP!
- In essence, the proton gradient is used ______________________________________
- For each NADH, up to _______________ ATP are produced
- For each $FADH_2$, __________________ ATP are produced
- Thus, a grand total of _________________________ ATP are produced per glucose!
  - compared to anaerobic respiration, which only produces 2 ATP per glucose, aerobic respiration is about ________________ times more efficient!
  - Aerobic respiration is even more efficient than an __________________________!
  - In spite of this high efficiency, only about 38% of the total energy found in glucose is captured. The other 62% is lost as _____________________!

Energy and Exercise

- When exercising, your body gets the ATP in three steps
  - 1) At first, the body uses _______________________ to produce ATP (lasts about 5-10 seconds)
  - 2) After that, the muscles run out of _____________, so they switch to lactic acid fermentation (lasts about ____________________________)
  - 3) Beyond that, ______________________ cellular respiration is the only way to keep up with ATP demands
    - runners pace themselves so that their muscles don't run out of oxygen
    - first, ________ molecules (glycogen) are broken down (lasts about __________)
    - after that, the body breaks down other molecules for energy (______________, then proteins)