Cellular Respiration Additional Notes

**Thought Questions:**

1. What is the purpose of NADH and FADH2?
2. What do positive and negative Delta G (Gibbs Free energy) values tell us about that step in a reaction? Use glycolysis diagrams provided in class to identify which steps are spontaneous or nonspontaneous based on this!
3. Explain coupling of reactions in the energy investment phase of glycolysis.
4. Do Hydrogens in the electron transport chain flow down or against their concentration gradient in order to produce ATP?

Write the input and output of each step of cellular respiration per glucose molecule

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| **Phase** | **Input** | **Output** |
| **Glycolysis** |  |  |
| **Pyruvate Oxidation** |  |  |
| **Citric Acid Cycle** |  |  |
| **Electron Transport Chain** |  |  |

Answer Key:

1. What is the purpose of NADH and FADH2?

Both molecules function as electron carriers and deliver electrons and hydrogens to the electron transport chain to produce ATP.

1. What do the positive and negative Gibbs Free energy values reveal about a reaction?

Gibbs free energy reflects the spontaneity of a reaction. A negative Gibbs corresponds to a spontaneous reaction while a positive Gibbs corresponds to a nonspontaneous reaction.

1. Explain reaction coupling in the energy investment phase of glycolysis.

The energy investment phase of glycolysis would be nonspontaneous without the coupling of an exergonic reaction to the endergonic energy investment phase. We therefore break ATP while we rearrange glucose in order to begin glycolysis.

1. Do hydrogens in the ETC flow down or against their concentration gradient to produce ATP?

Hydrogens flow down their gradient through ATP Synthase in order to produce ATP. This is why we use electron carriers to deliver both hydrogens and electrons; cleaving of the electrons from the electron carriers provides energy to move hydrogens against their concentration gradient into the inner mitochondrial membrane space which allows for their spontaneous flow down ATP synthase to produce ATP.

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| **Phase** | **Input** | **Output** |
| **Glycolysis** | Glucose; 2 ATP | 2 Pyruvate; 4 ATP; 2 NADH |
| **Pyruvate Oxidation** | 2 Pyruvate | 2 Acetyl CoA; 2 CO2; 2 NADH |
| **Citric Acid Cycle** | 2 Acetyl CoA | 6 NADH, 2 FADH2; 2 GTP; 4 CO2 |
| **Electron Transport Chain** | 10 NADH; 2 FADH2; O2 | H2O; 30 ATP |