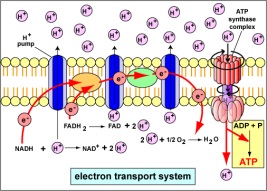
**Problem**: How is energy transferred and transformed in living systems?

**Background:**  Living organisms display the property of **metabolism**, which is a general term to describe the processes carried out to acquire and use energy. We know that people need to eat, and in our foods are various kinds of nutrients that our cells use. One large group of nutrients in our foods is carbohydrates, which supply our cells with glucose (C6H12O6). So the question is: How does the food we chew and swallow fuel our cells?. [**NGSS**: HS-LS1-7]

***Directions:*** Use *Model 3 – The Electron Transport Chain (ETC)* to answer the following questions.

1. What cell structure is the site for the electron transport chain? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. Label the carrier proteins in Model 3. By coloring them in and adding them to the key.

3. What substance do the carrier proteins transport across the inner mitochondrial membrane?

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**Read This Aloud!**

NADH and FADH2 molecules release hydrogen ions (H+) that are transported across the inner mitochondrial membrane with the help of electrons. The result of these multiple processes is the production of large amounts of ATP.

4. What high energy molecules are formed by the electron transport chain? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Refer to Model 3, what atom accepts the hydrogen ion at the end of the electron transport chain?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_What molecule is formed as a product of that acceptance? \_\_\_\_\_\_\_\_\_\_\_\_

7. Formulate an explanation for why the events of the electron transport chain constitute an aerobic

process rather than an anaerobic process (like glycolysis).\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Read This Aloud!**

Remember that glycolysis produces two pyruvic acid molecules per glucose molecule along with two of the hydrogen-carrying NADH molecules. Remember also that the Krebs cycle produces NADH as well as another hydrogen carrier called FADH2. It is important to know that during the electron transport chain, when each NADH gives up electrons and hydrogen ions, there is enough of a potential energy change to make three ATP molecules. When each FADH2 gives up electrons and hydrogen ions, there is enough of a potential energy change to make two ATP molecules.

8. Fill in the chart below to calculate the total amount of ATP produced from the breakdown of each glucose molecule during the three steps of cellular respiration

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Number of ATP produced from one glucose molecule** | **Number of H-Carriers produced from one glucose molecule** | |
| **NADH** | **FADH2** |
| Glycolysis |  |  |  |
| Krebs Cycle |  |  |  |
| Electron Transport Chain |  |  |  |
| Total ATP produced |  |  |  |
| **Grand Total ATP produced (add all 3 columns above)** | |  | |

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**Putting it all together**

1. Look at the equation for cellular respiration and write in which stage of the process each molecule is either used or produced.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **C6H12O6 + 6O2 → 6CO2  + 6H2O + 38 ATP** | | | | |
| Used in | Used in | Produced in | Produced in | Produced in |
|  |  |  |  |  |
|  |

2. Compare the ATP available to cells when oxygen is present versus when it is absent. How might this help explain why brain and heart functions are so quickly affected when a person cannot

breathe? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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