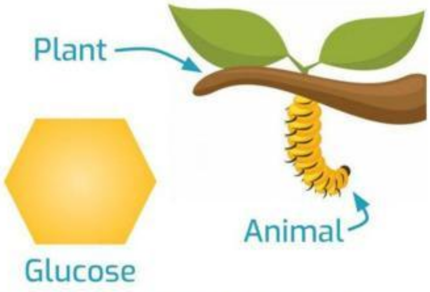
Activity#___: Cellular Respiration

Name:__________________________ Section:_________________

I. Directions: Read and analyze the paragraph and diagrams given. Answer the guide questions that follows. No Erasures!

Cells, and therefore organisms, need a constant supply of energy to power the processes that take place inside of them. For cells, this energy is typically glucose, an energy-rich carbohydrate. Plants produce glucose through photosynthesis, and animals eat foods that have glucose in them. Glucose is broken down by cells in a process called cellular respiration to produce ATP. Cells use the energy stored in ATP molecules to power cellular processes essential to life.



1. Cells need ______ to power their internal processes.

2. Cells get their energy from ______ molecules.

3. ______ is the process that converts the energy stored in glucose to energy stored in ATP.

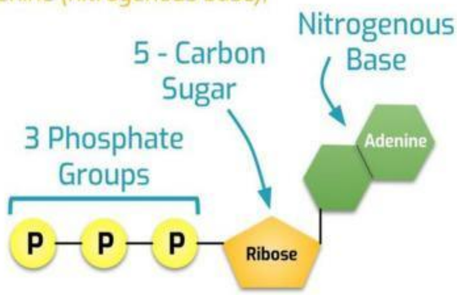
Glucose molecules carry too much energy to be useful to the cell, so the cell must convert them into a usable form of energy. To do this, the cell takes the chemical energy stored in glucose molecules and converts it into chemical energy stored in Adenosine Triphosphate (ATP). The cell then uses ATP to power reactions and other processes. ATP is made up of three parts: Adenine (nitrogenous base), Ribose (5-carbon sugar), and 3 Phosphate Groups.

4. ATP stands for ______.

5. Cells take the ______ energy stored in glucose and convert it into chemical energy stored in ATP.

6. How many phosphate groups does ATP have?

1 2 3 4 5



Adenosine Triphosphate (ATP)

The equation below shows the process of cellular respiration; it is the opposite of photosynthesis. Reactants are shown on the left side of the equation, and the products are on the right.

$$\underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Oxygen}}{6\,O_2} \rightarrow \underset{\text{Carbon Dioxide}}{6\,CO_2} + \underset{\text{Water}}{6\,H_2O} + \underset{\text{Energy}}{ATP}$$

7. List the two reactants in cellular respiration: ______ and ______

8. List the products in cellular respiration: ______, ______, and ______

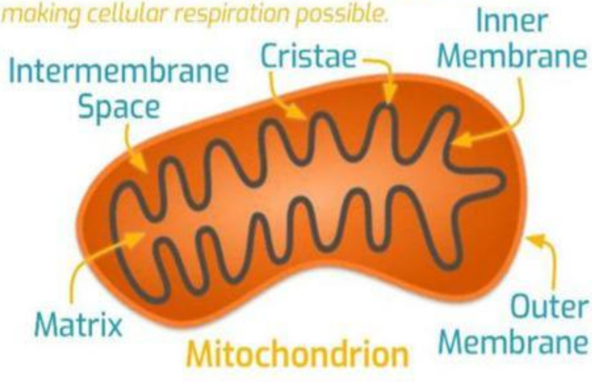
9. The process of cellular respiration is the opposite of ______.

Mitochondria are integral in cellular respiration. After some initial reactions take place in the cytoplasm, the rest of cellular respiration happens within this organelle. A mitochondrion is made up of 2 membranes, an outer and an inner. The inner membrane is folded many times to form cristae. The area between the two membranes is called the intermembrane space, while the area inside the inner membrane is called the matrix. The two membranes separate molecules making cellular respiration possible.

10. Most of the reactions in cellular respiration happen in the ______.

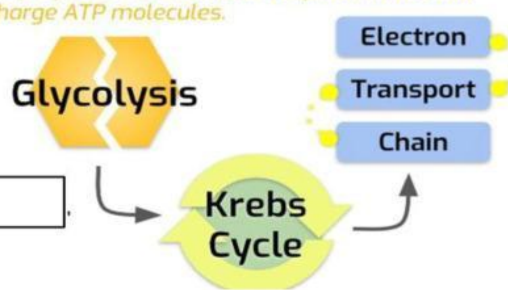
11. The mitochondria has ______ membranes.

12. ______ are folds in the inner membrane and the fluid found inside is the ______.



The 3 Steps of Cellular Respiration

Cellular respiration starts with a single glucose molecule. The process takes place in the cytoplasm and the mitochondrion in three main steps. The three steps are glycolysis, the Krebs cycle, and the electron transport chain (ETC). In between glycolysis and the Krebs cycle, there is an intermediate step in which one molecule is transferred into another (pyruvate to acetyl CoA). By the end of cellular respiration, the cell will have broken down glucose and used the energy to recharge ATP molecules.



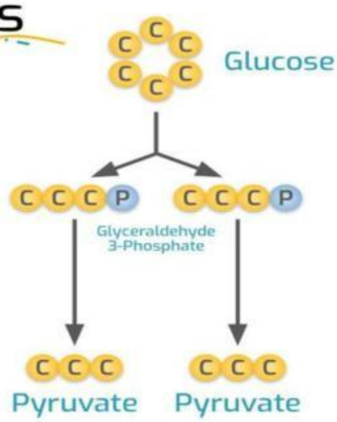
13. Cellular respiration starts with a single molecule of ______.

14. The three steps of cellular respiration are:

15.
16. ______, ______, and ______

Step 1 - **Glycolysis**

Glycolysis, the first step in cellular respiration, occurs in the cytoplasm. The word glycolysis means "glucose splitting." Glycolysis is a pathway of ten reactions completed by ten enzymes. By the end of the reactions, glucose is broken down into two pyruvate molecules. Glucose ($C_6H_{12}O_6$) has six carbon atoms and pyruvate ($C_3H_4O_3$) has 3 carbon atoms.



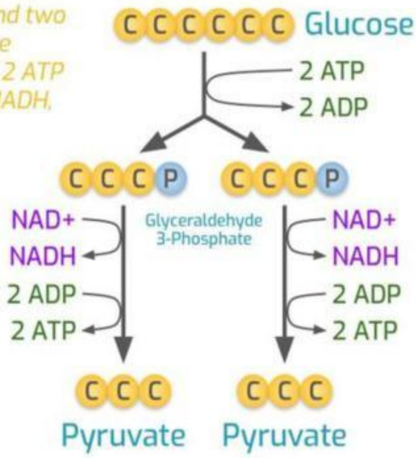
17. The first step of cellular respiration is ______.

18. Glycolysis means "______."

19. The ten steps in glycolysis break apart a glucose molecule into two ______ molecules.

20. Pyruvate molecules have ______ carbon atoms.

In order to split glucose into two pyruvate molecules, cells must spend two ATP molecules for every molecule of glucose converted. However, the process of glycolysis also creates 4 ATP molecules, for a net yield of 2 ATP molecules. Also during glycolysis, electrons are freed and added to NADH, an electron carrier. The NADH travel to the final stage of cellular respiration, the electron transport chain to make more ATP.



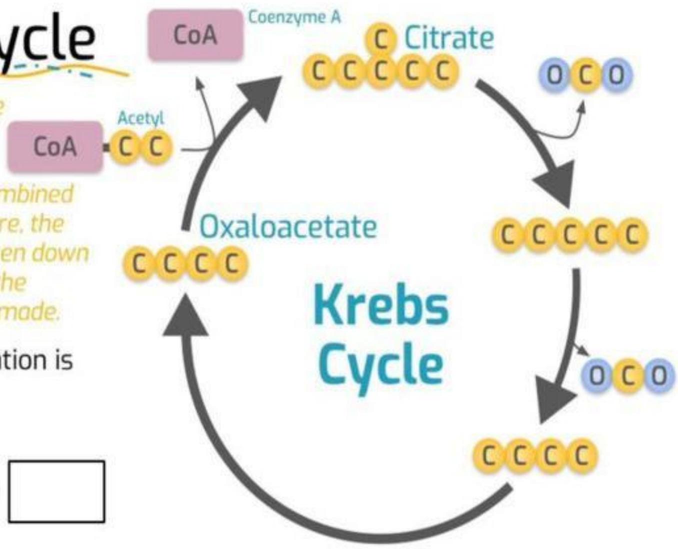
21. The cell must use ______ ATP to power glycolysis.

22. The net yield of ATP from glycolysis is ______ ATP.

23. NADH are ______ that move electrons from glycolysis to the electron transport chain.

Step 2 - **Krebs Cycle**

The second step in cellular respiration is the Krebs Cycle (or citric acid cycle) and takes place in matrix of the mitochondria. To start the Krebs cycle, the acetyl group is combined with oxaloacetate to form citrate. From there, the acetyl molecule will be systematically broken down to harvest the electrons and send them to the electron transport chain where ATP will be made.



24. The second step of cellular respiration is the ______.

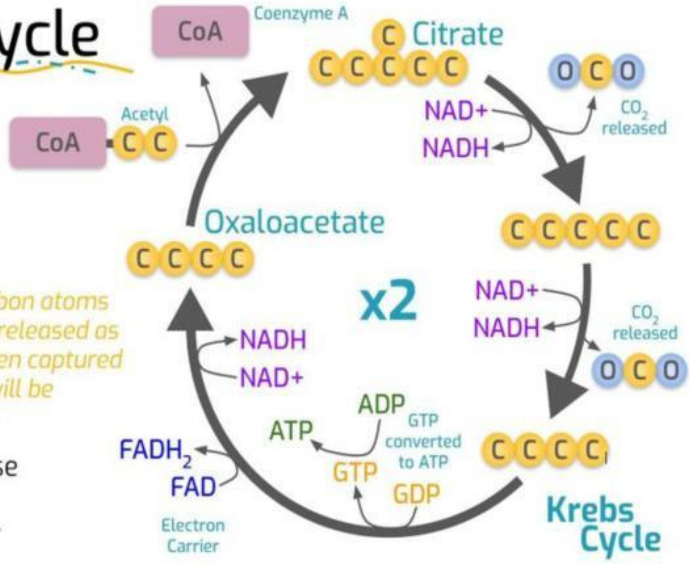
25. The Krebs Cycle takes place in the ______ of the mitochondria.

Step 2 - **Krebs Cycle**

The Krebs Cycle happens twice for each molecule of glucose processed because glycolysis split glucose into two pyruvate. After two rounds, the Krebs Cycle yields:

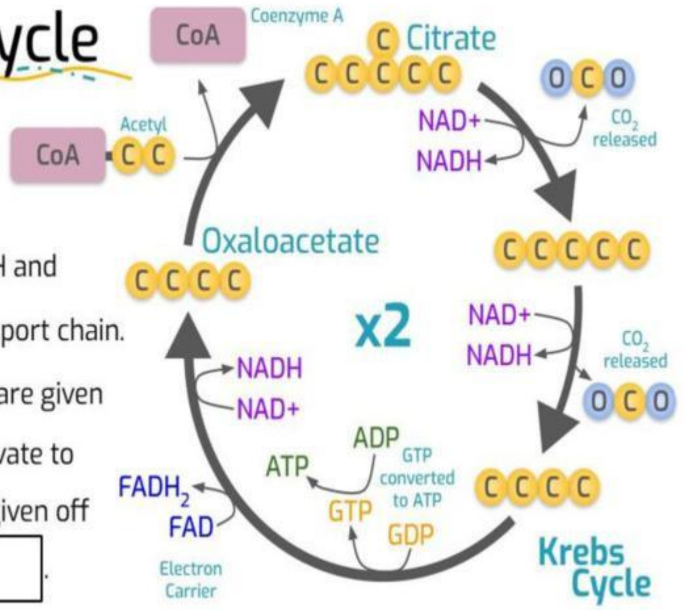
- *2 ATP*
- *4 CO_2*
- *6 NADH*
- *2 $FADH_2$*

By the end of the Krebs Cycle, all of the carbon atoms in the original glucose molecule have been released as carbon dioxide. All of the electrons have been captured by electron carriers NADH and $FADH_2$ and will be transferred to the electron transport chain.



26. The carbon atoms found in glucose are released as ______.

Step 2 - **Krebs Cycle**



27. In the Krebs Cycle, ______ ATP

28. and ______ NADH are created.

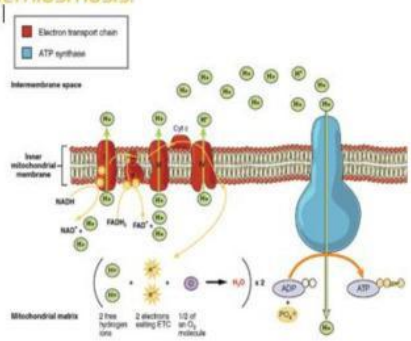
29. The two electron ______, NADH and $FADH_2$, travel to the electron transport chain.

30. Two molecules of carbon dioxide are given

31. off during the conversion of pyruvate to acetyl-CoA and ______ more are given off during the Krebs Cycle to total ______.

Step 3 - **The ETC**

The final step of cellular respiration is the electron transport chain (ETC) and chemiosmosis. These two processes rely on each other to convert the high-energy electrons from the previous stages into ATP. The ETC is a series of proteins found in the inner membrane in the mitochondria. They accept the electrons from the electron carriers NADH and $FADH_2$ and use some of the electrons' energy to pump hydrogen ions (H^+) across the inner membrane. These H^+ ions will be used in chemiosmosis.



32. Step 3 of cellular respiration includes the

33. ______ and ______

34. The ETC is powered by high-energy ______ dropped off by electron carriers NADH and $FADH_2$.

35. The ETC pumps ______ ions across the membrane.

36. Electrons from the ETC combine with Oxygen and Hydrogen ions to form ______ molecules and end to produce 32 – 34 ATP.