

Ch 9 Cellular Respiration: Harvesting Chemical Energy

Review Questions

- Starting with glucose ($C_6H_{12}O_6$), write the overall reactions for aerobic respiration.
$$C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2 + 38ATP$$
- How is aerobic cellular respiration the opposite of photosynthesis?
$$C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2 + 38ATP \quad \text{CELLULAR RESPIRATION}$$

$$6H_2O + 6CO_2 + \text{sunlight} \rightarrow C_6H_{12}O_6 + 6O_2 \quad \text{PHOTOSYNTHESIS}$$

If we look at the two reactions closely we notice that the products for cellular respiration are the reactants for photosynthesis and the products for photosynthesis are the reactants for cellular respiration. Basically the two reactions are the reverse of each other.
- Name the five stages of cellular respiration.
Cells that completely break down glucose into carbon dioxide and water during aerobic cellular respiration have the following five stages: glycolysis, transition reaction, Krebb's cycle, electron transport chain (system) and chemiosmosis.
- Where in the cell does glycolysis take place?
All cells whether they have mitochondria or not have glycolysis occurring within the cytosol of the cell. Only those cells that utilize oxygen continue to extract energy from the pyruvate formed from glycolysis.
- How much ATP is required to split a glucose molecule in half?
An initial input of two (2) ATP molecules is required to start the process of glycolysis.
- What is the net gain in ATP at the end of glycolysis?
At the end of glycolysis there are four ATP molecules formed, but there will only be a net gain of two(2) ATP molecules since two ATP molecules were used in the energy investment stage of glycolysis.
- What is the difference between fermentation and aerobic cellular respiration?
"One catabolic process, fermentation, is a partial degradation of sugars that occurs without the use of oxygen. However, the most prevalent and efficient catabolic pathway is cellular respiration, in which oxygen is consumed as a reactant along with the organic fuel (*aerobic* is from the Greek *aer*, air and *bios*, life). The cells of most eukaryotic and many prokaryotic organisms carry out aerobic cellular respiration." (Text quoted from page 163 of the textbook)
- Which produces more ATP per glucose molecule, fermentation or aerobic cellular respiration?
During aerobic respiration a glucose molecule can yield 38 ATP molecules while the process of glycolysis yields only 2 ATP molecules for each glucose molecule consumed. Thus it is easy to see that Aerobic respiration yields 19 times more ATP than fermentation.
- Identify the products for each of the stages of cellular respiration.
Glycolysis forms the products of pyruvate which still have some potential energy that can be extracted during the subsequent stages of cellular respiration. In addition to the pyruvate, 2 NADH are formed and enter the electron transport chain and a net gain of 2 ATP molecules also are produced in glycolysis. During the transition reaction, each pyruvate is converted into Acetyl Coenzyme A and a carbon dioxide molecule is formed. In addition a molecule of NADH is also formed for each pyruvate molecule during the transition reaction. This