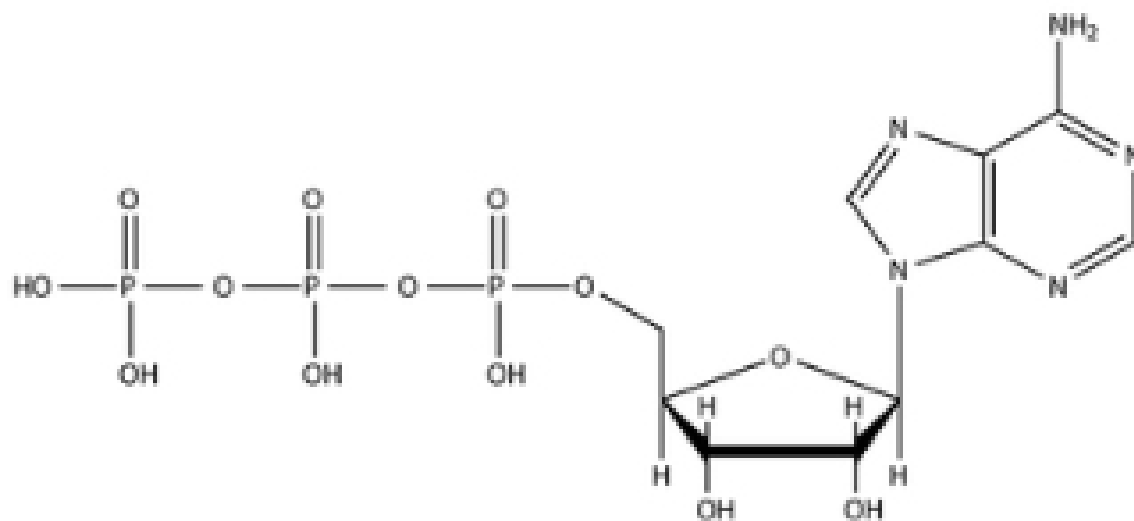
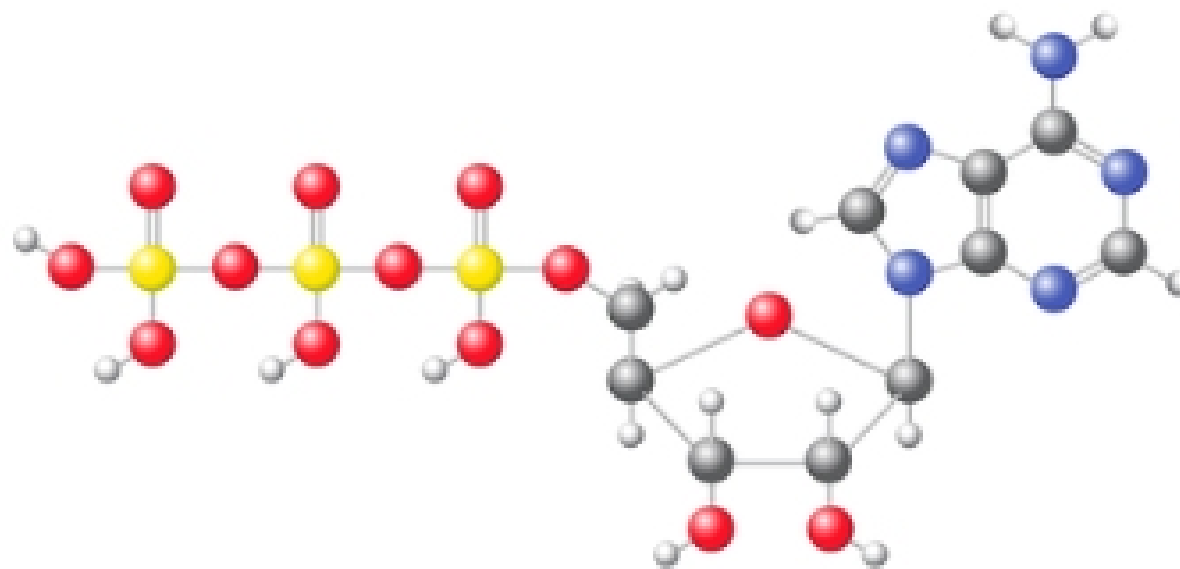


Cellular Respiration

Animals metabolize food through a process known as cellular respiration. Cellular respiration is a catabolic process. That is, a food is broken down in order to release energy. How an organism utilizes food for energy is known as their metabolism. Enzymes are needed in order for animals to make the process energy efficient. A series of enzymes help humans perform cellular respiration and take food (carbohydrates, proteins and lipids) and turn them into useable energy. Cellular respiration takes place in the cytoplasm and mitochondria.

The energy that cellular respiration produces is known as ATP, or adenosine triphosphate.

Adenosine triphosphate (ATP)



ATP has the ability to release energy that can be used in cellular processes when a phosphate bond is broken. The ADP (adenosine diphosphate) is then sent back to be phosphorylated once again. There are also energy molecules that participate in the cellular respiration process. They are different from ATP. NADPH and FADH₂ are two electron carrier molecules that can also help in the cellular respiration process.

Cellular respiration begins with a process known as glycolysis. In glycolysis, a glucose molecule is broken down into two pyruvic acid molecules. While it takes two ATP to complete this process, it also produces two ATP. The pyruvic acid is then free to cross the mitochondrial membrane. Once this occurs, pyruvic acid can then combine with an enzyme known as Coenzyme A. This reaction produces acetyl-Co-A, a compound that can then be utilized to move into the Krebs Cycle.

The Krebs Cycle is a cyclic cycle that begins when acetyl-Co-A is converted to citric acid. It is for this reason that the Krebs Cycle is sometimes known as the Citric Acid Cycle. The Krebs cycle will produce 3 NADH, 1 FADH₂ and 1 ATP when it runs through to completion using 1 acetyl-Co-A molecule. The creations of the electron carrier molecules (NADH and FADH₂) are very important because they are needed to run the next step in cellular respiration, the electron transport chain.

The final step in cellular respiration is the electron transport chain ([Biology101 electron transport page](#)). This takes place in the mitochondria and is responsible for the creation of a great deal of ATP. The electron transport chain begins when NADH and FADH₂ release their electrons. These electrons power proton pumps that can then have the energy needed to pump hydrogen ions across the membrane (against the concentration gradient). The hydrogen molecules will then seek out ATP synthase. ATP synthase is an enzyme embedded in the mitochondrial membrane. It will allow the hydrogen ions to pass through and will create ATP with each hydrogen ion that passes through. The final electron acceptor of the electron transport chain is

oxygen. As a result of oxygen accepting the final electron, this process is known as an aerobic process.

There is an alternative pathway to cellular respiration that can occur when there is not enough energy being produced by cellular respiration alone. This is known as lactic acid fermentation and it is an anaerobic process that does not require oxygen. In this process additional ATP are produced directly from the products of glycolysis. However, this additional ATP comes with a price; lactic acid can build up in the muscle locations where this process is run. This can be unfavorable because lactic acid can cause muscle cramping. This is why an individual who is running can get horrible cramps when they have run for a while. This is also why individuals who have blockages in their arteries can feel pain just before a heart attack. The pain a heart attack victim feels before and during a heart attack is directly proportional to the amount of lactic acid that has built up in that region.

Only yeast can run alcoholic fermentation. This is a process similar to lactic acid fermentation. Yeasts are very small organisms. They do not require a large amount of energy in the form of ATP to run their life processes. They are able to metabolize sugars to create ATP. This too, comes with a drawback. The waste of alcoholic fermentation is of course, alcohol. If too much alcohol builds up where the yeast is metabolizing it can eventually poison them.

The metabolism of a human does not rest solely on the consumption of carbohydrates. There are alternative pathways that are run in our metabolism that can utilize both lipids and proteins to create ATP. The majority of these pathways require both lipids and proteins to be broken down into acetyl-Co-A. Once they are metabolized to this compound, they can go on to run Krebs and the electron transport chain.