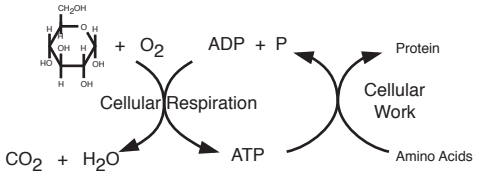
Cellular Respiration

An Introduction to

Energy Transformation in Living Things

and its importance in

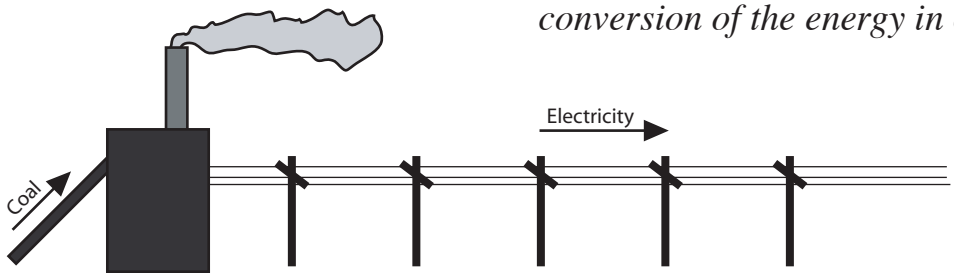
Intercellular Maintenance



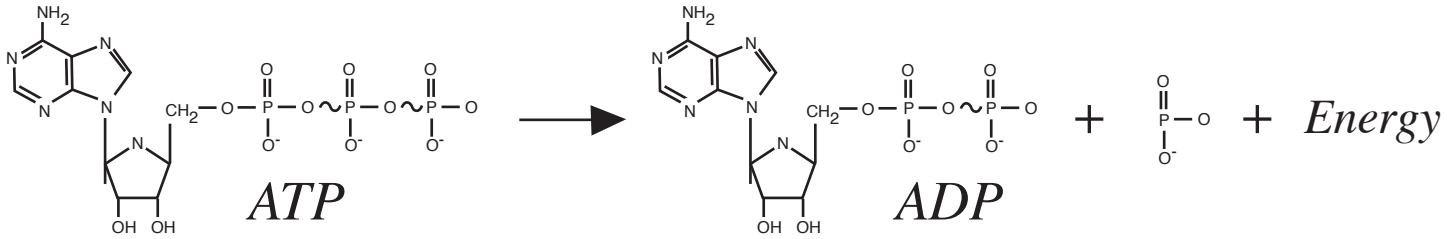
By Noel Ways

Cellular Respiration

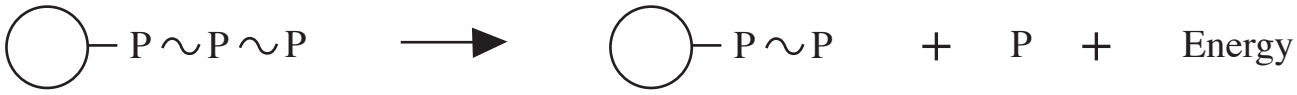
Energy exists in many forms and may be converted from one form into another. A familiar example is the conversion of the energy in coal into electricity.



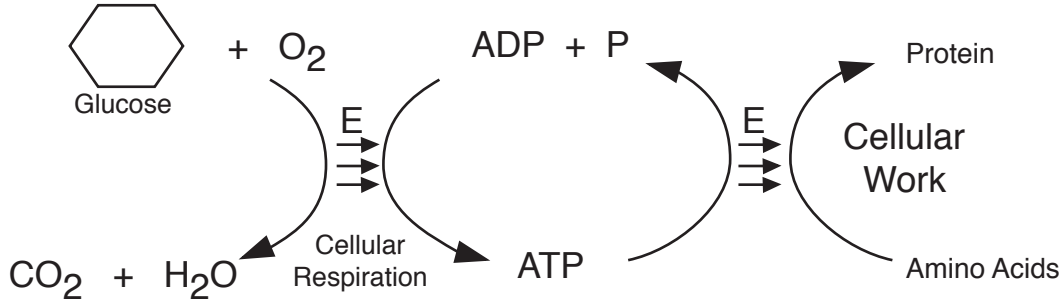
There are many potential sources of energy for living things. However, for energy to be available for metabolic purposes, it must be converted into a particular chemical from. Usable energy must be in the form of chemical bonds of a molecule called ATP (Adenosine Triphosphate).



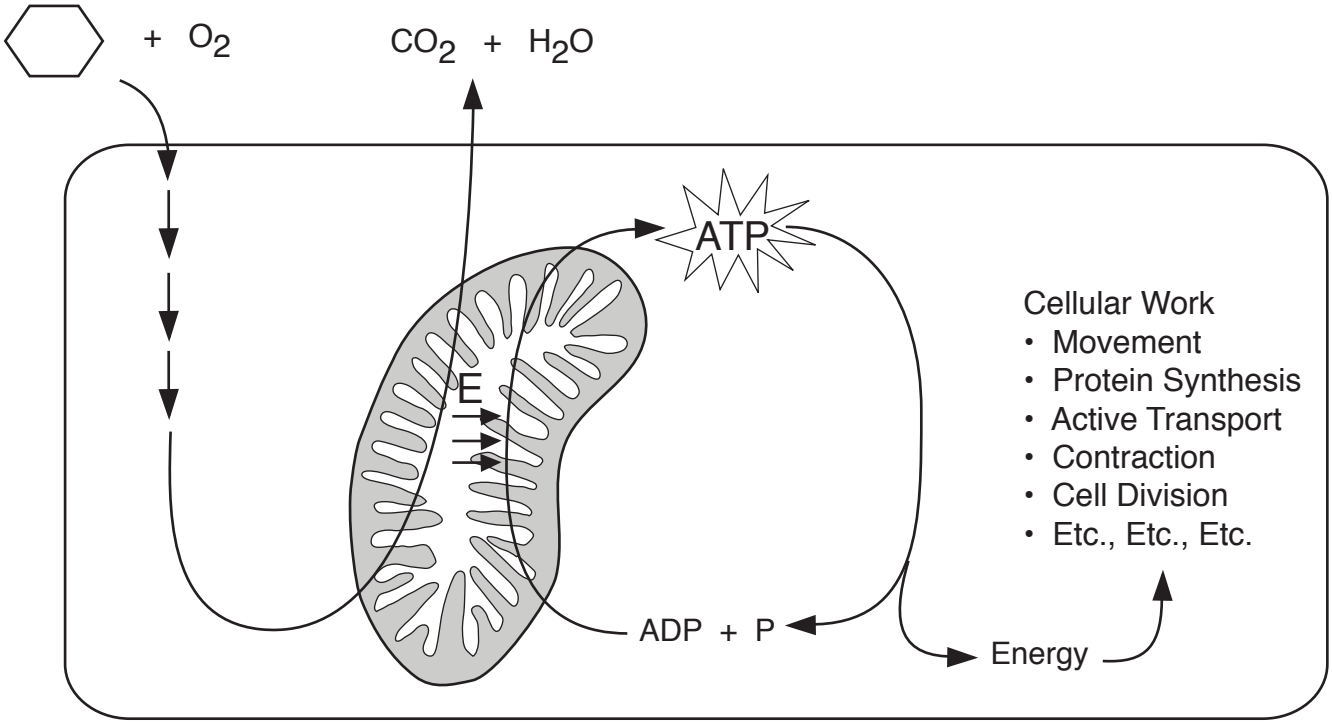
Note that ATP has three phosphate groups ($\overset{O}{\overset{\|}{P}}-O^-_{O^-}$). Between these phosphate groups are "high-energy bonds" represented by a "~". If one of these bonds is broken, the energy associated with the bond is released and can be used by the cell to do cellular work. Illustrated more simply:



The generalized process illustrated below demonstrates glucose being catabolized (digested) into CO_2 and H_2O. During this catabolic process energy released is used to anabolize (synthesize), ADP + P into ATP. Energy is again available in the form of high energy bonds (~) to do cellular work.

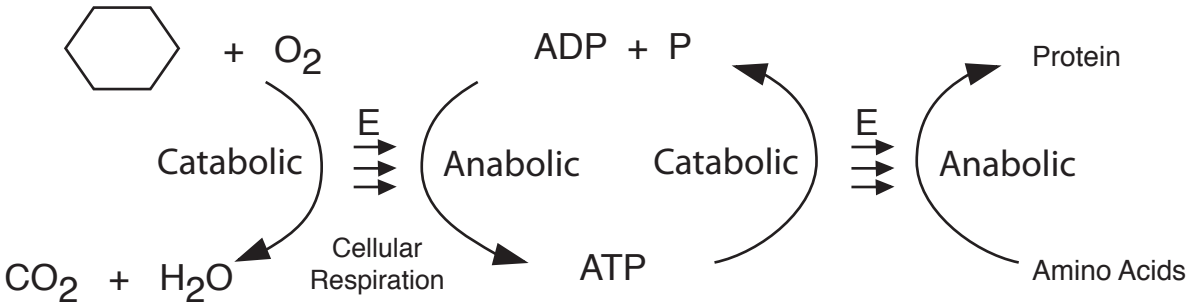


When glucose enters the intracellular fluid, metabolic pathways allow it to be catabolized in a controlled manner. At a particular point, one of the intermediate compounds of this breakdown process enters the mitochondria ("powerhouse of the cell"), where the catabolic process continues and a transfer of energy to the high-energy bonds of ATP (~) occurs.



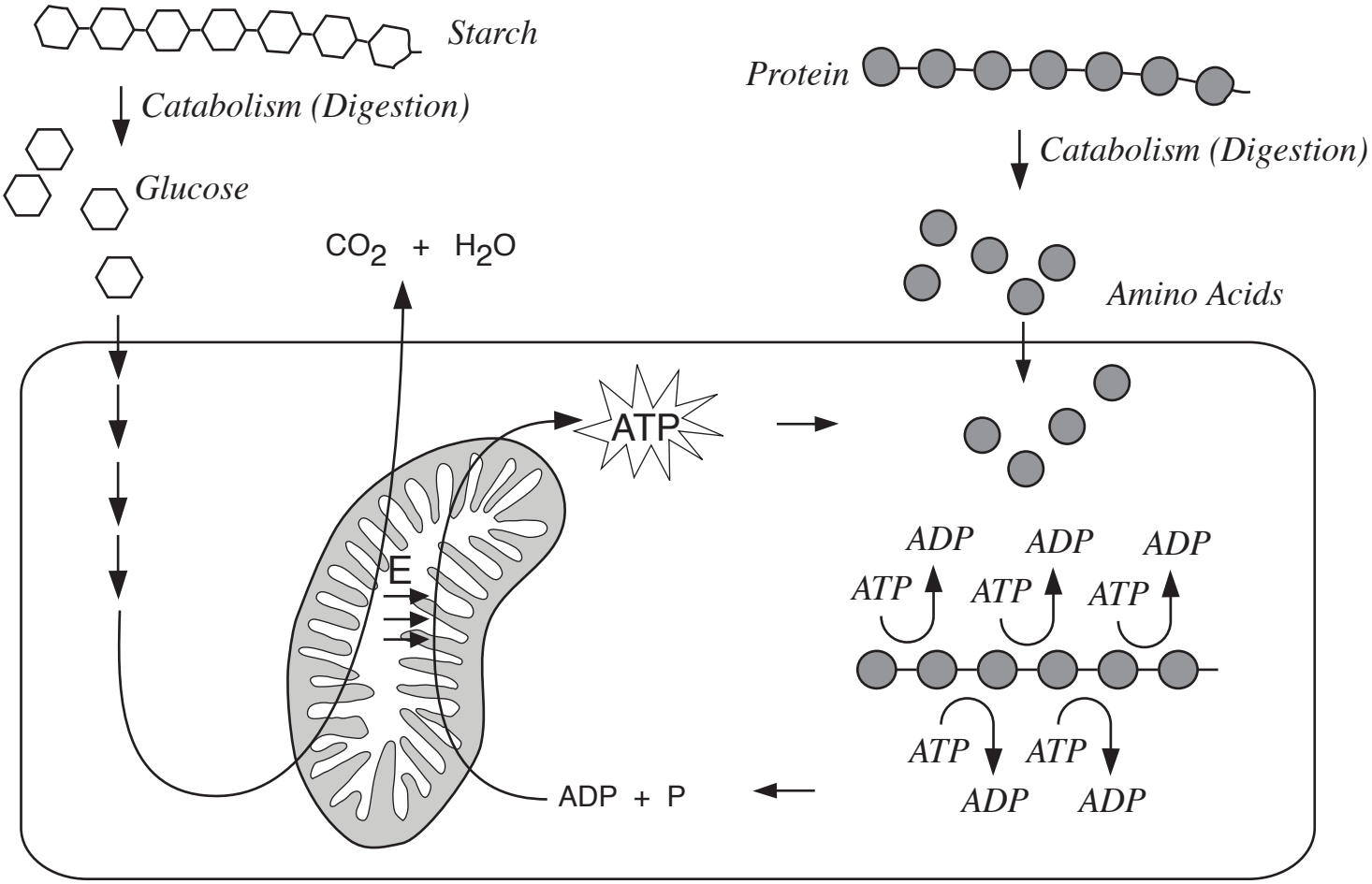
Once ATP is synthesized, it can then be used to do "cellular work." It will leave the mitochondria and be used where needed. The ATP/ADP system or cycle can be likened to a rechargeable battery. ATP is the recharged state, ADP is the discharged state.

It is also noteworthy that anabolic reactions generally do not occur unless a catabolic reaction occurs simultaneously. Typically, it is the catabolic reaction that supplies the energy to drive the anabolic reaction.



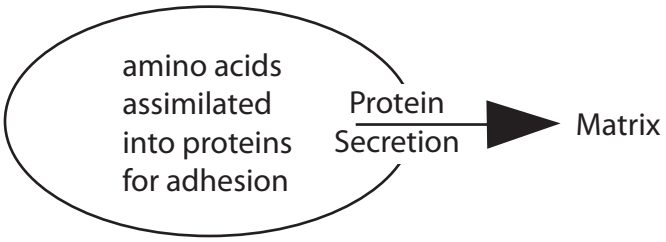
We may define metabolism as the "sum total of all biochemical reactions that occur in the body." Clearly, cellular respiration is an important part of metabolism as are all the other reactions that it enables.

During the catabolic breakdown of starch, glucose is released and absorbed into the blood and delivered to the cells for ATP production purposes. Protein is likewise broken down (catabolized) into amino acids, and these are also absorbed and then assimilated within the organism. Assimilation cannot occur without the ATP provided by cellular respiration.



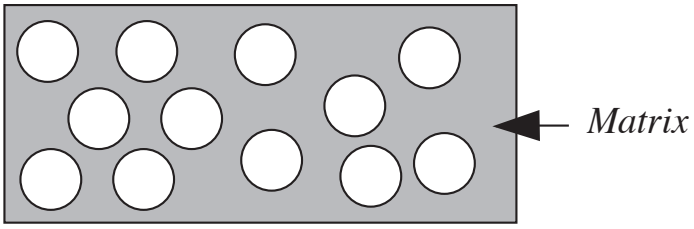
When considering of the cellular makeup of the body, it is important to appreciate that all cells live in a dynamic community. Consequently, each cell is dependent on the proper functioning of the other cells. Failure of one cell type to perform its particular function will result in failure of other cells and tissues to perform properly.

This interdependence of body cells and tissues can be broadly categorized into two fundamental issues: Adhesion of cell one to another, and communication between the many cells that make up the body.



1. Adhesion. In order for cells to bind one to the other, a non-living material called matrix (sometimes called an intercellular cement) bonds one cell to another cell. The protein components of the matrix are anabolized with the cells and then secreted outside of the cell.

This protein based, non-living material, that holds the cells together is called matrix.



2. Intercellular communication. Vital to body maintenance is the ability of cells and tissues to communicate. An example of intercellular communication occurs when blood glucose levels are elevated. The pancreas responds by assimilating and secreting a chemical messenger (hormone) called insulin into the blood. Insulin then binds to receptors on liver cells, and the liver responds by removing the glucose from the blood and storing it. This restores normal blood glucose levels.