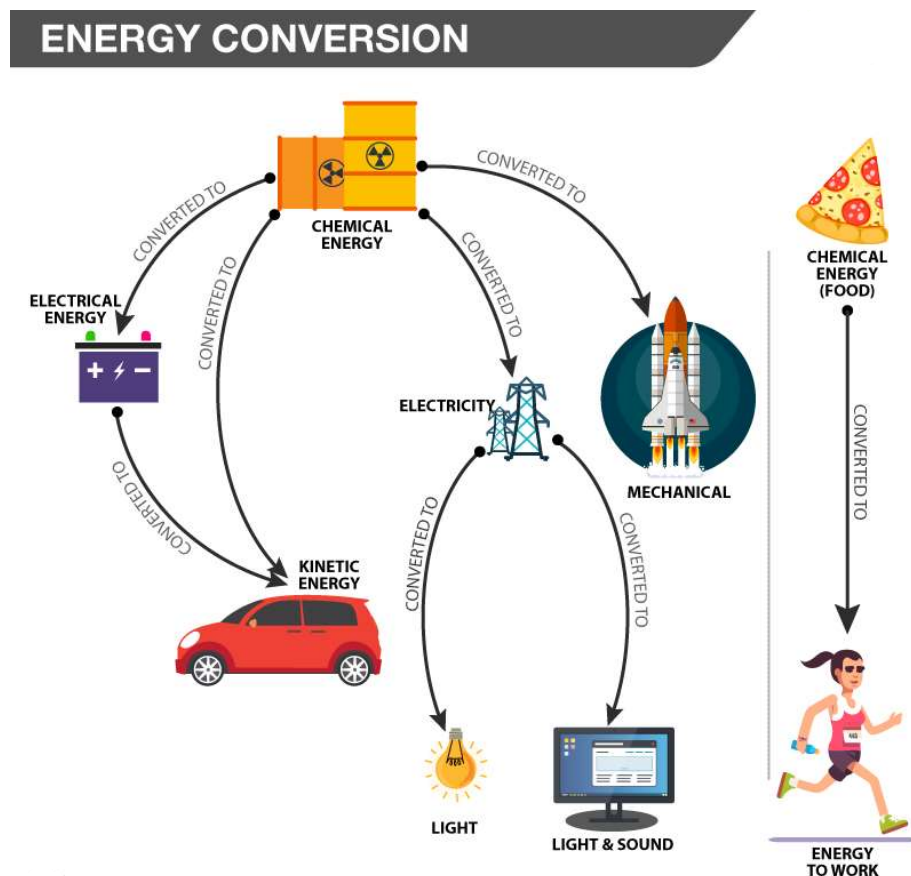


1) How is a chemical gradient converted to Mechanical energy? Provide a biological example.

⇒ A chemical gradient can be converted to mechanical energy through the process of chemiosmosis, which occurs in the mitochondria of cells. In chemiosmosis, protons (H^+) are pumped across the inner mitochondrial membrane, creating a concentration gradient. This gradient is then used to power the movement of ATP synthase, an enzyme that generates ATP, the energy currency of cells.

Chemiosmosis starts with the pumping of protons (hydrogen ions) from the matrix of the mitochondria (the inside) to the intermembrane space (the space between the two membranes that make up the mitochondria). This pumping of protons creates a concentration gradient, with a higher concentration of protons in the intermembrane space compared to the matrix.

The proton concentration gradient is then used to generate ATP (adenosine triphosphate), which is the main source of energy for cells. This occurs through the action of ATP synthase, an enzyme that is embedded in the inner membrane of the mitochondria. ATP synthase uses the energy stored in the proton concentration gradient to synthesize ATP from ADP (adenosine diphosphate) and inorganic phosphate.



As the protons flow back into the matrix through ATP synthase, they cause the enzyme to rotate, which in turn causes the synthesis of ATP. In this way, the chemical gradient of protons across the mitochondrial membrane is converted to mechanical energy in the form of the movement of ATP synthase, which is then used to synthesize ATP.

An example of this process can be seen in the production of ATP during cellular respiration. During cellular respiration, glucose is broken down through a series of reactions that release energy. Some of this energy is used to pump H^+ ions across the inner mitochondrial membrane, creating a concentration gradient. The movement of H^+ ions back across the membrane through ATP synthase converts this chemical gradient into the mechanical energy needed to synthesize ATP. This ATP can then be used by cells for various functions, such as muscle contraction and cell division.