Law of Thermodynamics-1

Dr Anita Kumari

Deptt. Of Zoology

L.S.College

Thermodynamics is the study of energy changes, that is, the conversion of energy from one form into another. Such changes obey the first two laws of thermodynamics.

The First Law of Thermodynamics:

The first law is concerned with the conversion of energy within a "system," where a system is defined as a body (e.g., a cell or an organism) and its surroundings.

This law, which applies to both biological and non-biological systems, states the following: Energy cannot be created or destroyed but can be converted from one form into another: during such a conversion, the total amount of the energy of the system remains constant.

This law applies to all levels of organization in the living world; it applies to organisms, cells, organelles, and to the individual chemical reactions that characterize metabolism. It is difficult to measure the energy possessed by cells (i.e., to limit the "system" to an individual cell), because energy may escape into the environment surrounding the cell during the measurement.

Similarly, energy may be acquired by the cell from its environment; for example, a photosynthesizing cell absorbs energy from its environment in the form of light. A cell's acquisition of energy from its environment (or its loss to the environment) should not be confused with the destruction or creation of energy, which according to the first law of thermodynamics does not occur.

From a biological viewpoint, the first law of thermodynamics indicates that at any given moment a cell possesses a specific quantity of energy.

This energy takes several forms; it includes:
(1) Potential energy (e.g., the energy of the bonds that link atoms together in a molecule or the pressure-volume relationships within the cell as a whole or within membrane- enclosed intracellular components);

(2) Electrical energy (e.g., the distribution of different amounts of electrical charge across cellular membranes); and

(3) Thermal energy (e.g., the temperature-dependent constant and random motions of molecules and atoms).

According to the first law, these forms of energy may be inter-converted; for example, some of the cell's potential energy can be converted into electrical or thermal energy, but the cell cannot create or destroy energy. When a cell breaks down a polysaccharide to ultimately form CO_2 and H_2O, some of the potential energy present in the carbohydrate is conserved as potential energy by phosphorylating ADP, thereby forming ATP.
The ATP so produced represents a new energy source (and also one that is of greater immediate utility for the cell). However, not all of the energy of the original carbohydrate is conserved as potential energy; some of it becomes thermal energy and is transferred to the surroundings as heat. It is important to recognize that none of the energy is destroyed and it should be possible to account for all of the energy originally present in the polysaccharide in other forms within the system (i.e., in the ATP that is produced and in the heat that is released).