Biophysical Chemistry
First Law of Thermodynamics
Lecture-1

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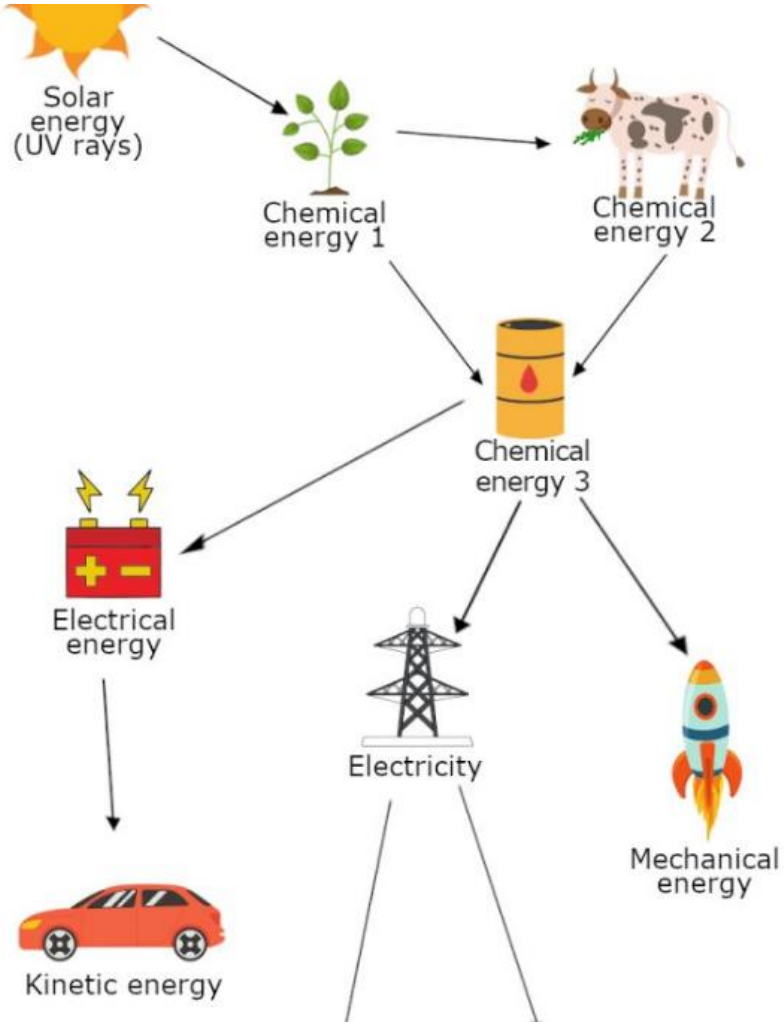
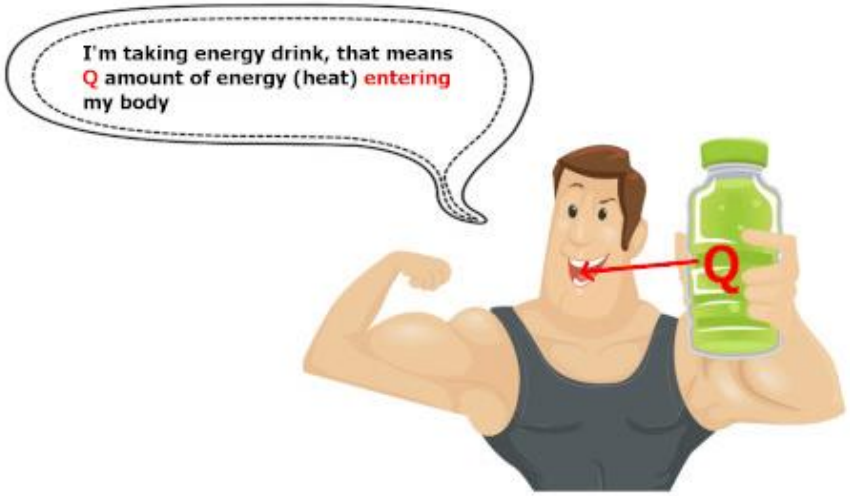
Thermodynamics

Thermodynamics is the branch of physics that deals with the relationships between heat and other forms of energy. In particular, it describes how thermal energy is converted to and from other forms of energy and how it affects matter. The fundamental principles of thermodynamics are expressed in four laws.

Flow of Energy





This boy takes the energy drink and he gains Q amount of energy from it. We can say that Q amount of energy is entering the body.

Now what have you noticed from the above Image? You can see that this body builder has gained Q amount of energy and he is ready to do work. And right now, he is having total energy E1.

Now this muscular body spends some W amount of energy in doing work (here weight lifting), After doing this work, his total energy becomes E2.

This equation is known as the first law of thermodynamics.

$$\Delta E = Q - W$$

(Net change in total energy) (Heat added) (Work done)

- **First law of thermodynamics: The net change in total energy of a system (ΔE) is equal to the heat added to the system (Q) minus work done by the system (W).**

First Law of Thermodynamics

The first law of thermodynamics is generally thought to be the least demanding to grasp, as it is an extension of the law of conservation of energy, meaning that energy can be neither created nor destroyed. However much energy there was at the start of the universe, there will be that amount at the end. However, thermodynamics is a subtle subject, and the first law is much more interesting than this remark might suggest. Moreover, like the zeroth law, which provided an impetus for the introduction of the property “temperature” and its clarification, the first law motivates the introduction and helps to clarify the meaning of the elusive concept of “energy.”

The **first law of thermodynamics** states that the change in internal energy of a system is equal to the work done by or to the system and the heat that flows in or out of it.

This means that if energy is input to a system by doing work on it, then it will get hotter. If the system is to stay the same temperature, then you must remove heat from the system .

The first law of **thermodynamics** is a generalization of the law of conversion of energy, which states that energy can neither be created nor destroyed.

Explanation of First Law of Thermodyanmics

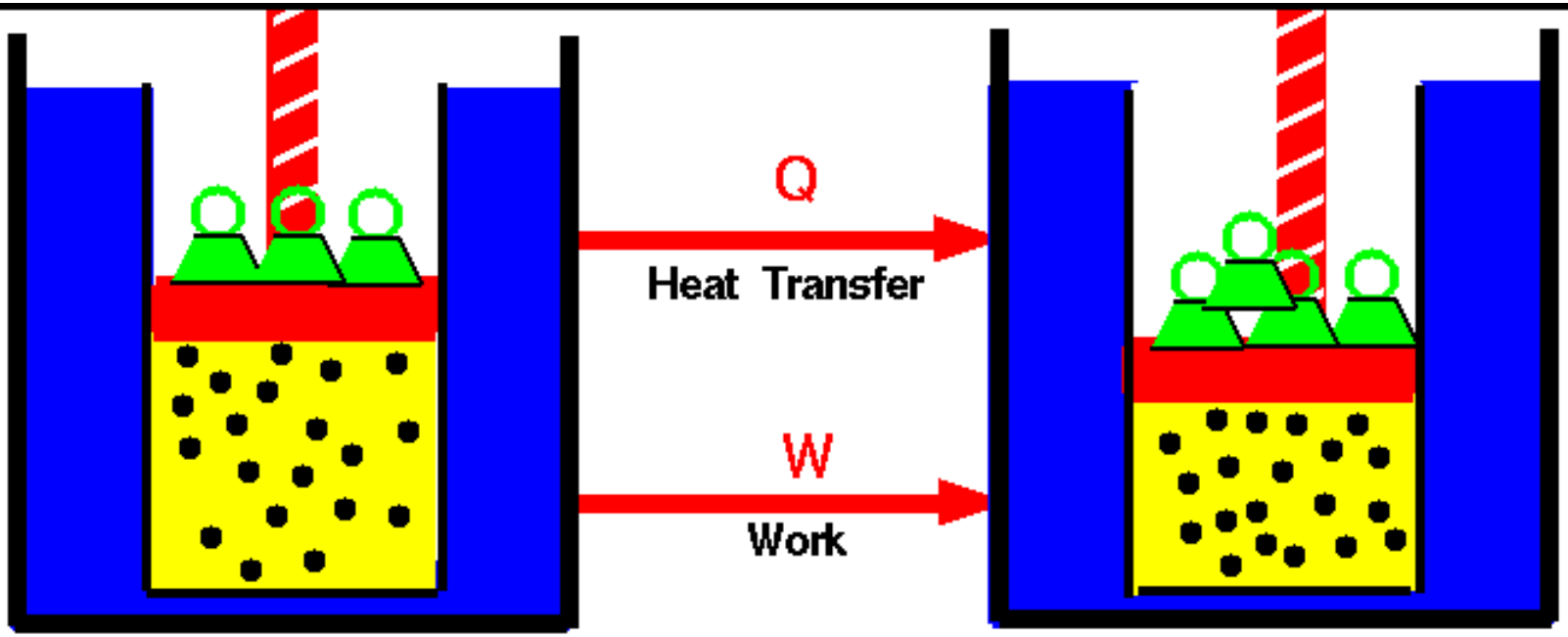
The change in internal energy of a system is equal to the heat added to the system minus the work done by the system.

$$\Delta U = Q - W$$

Change in internal energy

Heat added to the system

Work done by the system



E = Internal Energy

$E_2 - E_1 = Q - W$

Any thermodynamic system in an equilibrium state possesses a state variable called the internal energy (E). Between any two equilibrium states, the change in internal energy is equal to the difference of the heat transfer into the system and work done by the system.

Four Laws of Thermodynamics

Zeroth law

"If two bodies A and B are in thermal equilibrium with third body C, then body A and B are also in thermal equilibrium with each other"

First law

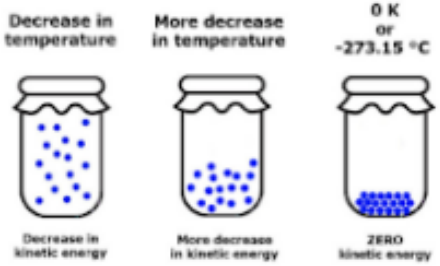
$$\Delta E = Q - W$$

"The net change in total energy of a system (ΔE) is equal to the heat added to the system (Q) minus work done by the system (W)"

Second law

"In all the spontaneous processes, the entropy of the universe increases"

Third law



"The value of entropy of a completely pure crystalline substance is zero at absolute zero temperature"