Quadrant II – Transcript and Related Materials

Programme : Bachelor of Science (Third year)

Subject : BOTANY

Course Code : BOC-110

Course Title : PLANT ECOLOGY AND PHYTOGEOGRAPHY

Unit No. : VIII

Unit name : Functional aspect of ecosystem

Module Name: Principles of energy flow

Name of the Presenter: Ms. Diksha Datta Gaunker

Notes:

Concept of energy:

Energy is the capacity to do work. Biological activities require consumption of energy which ultimately comes from the sun. radiant energy of sun (or solar energy) is transformed into chemical energy by the process of photosynthesis – this is stored in plant tissue and then transformed into mechanical and heat form of energy during metabolic activities. In the biological world the energy flows from the sun to plants and then to all heterotrophic organisms, such as microorganisms, animal and man.

Mechanical energy has 2 forms namely, kinetic or free energy and potential energy. The energy a body posse by virtue of its motion is called kinetic energy, and is measured by the amount of work done in bringing the body at rest.

Potential energy is stored energy (the energy) at rest and becomes useful after conversion into kinetic energy. All organism requires a source of potential energy is found in the chemical energy of food. The oxidation of food released energy which is used to do work. Thus, chemical energy is converted into mechanical energy. Food means material containing energy that organisms can use. Food is the means to transfer of both matter and energy in the living world. Plant synthesize food with the help of solar energy and inorganic substance such as nutrients, such as CO_2 and H_2O in a biochemical process called photosynthesis.

Units of Energy:

The unit of measurement of energy is erg. One crore ergs is equals to 1 Joule (J). All forms of energy can be converted into heat energy (Calories). For a better & uniform expression in ecology, energy is measured in terms of Joules not in ergs or unit of heat measurement.

First law of thermodynamics

The first law of thermodynamics is the law of conservation of energy, which says that energy may be transformed from one form to another form but is neither created nor destroyed. If there is increase or decrease occurs in the internal energy (ΔE) of the ecosystem itself, work (W) is done and heat (Q) is neither evolved nor destroyed.

$$\Delta E = W + Q$$

For example, combustion (direct chemical reaction) of food release the following amount of energy:

$C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2 + 673$ kcal (2816 kJ)

The fermentation is two step reaction, but release the same amount of energy.

1) $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 + 18$ kcal (75kJ)

2) $2C_2H_5OH + 6O_2 \rightarrow 6H_2O + 4CO_2 + 655$ kcal (2740 kJ)

(1+2) $C_6H_{12}O_6 + O_2 \rightarrow 6H_2O + 6CO_2 + 673$ kcal (2815 kJ)

This law explains the interconvertibility of all form of energy but does not refer to the efficiency of transformation or conversion. In ecological systems solar energy is converted to chemical energy stored in food materials which is ultimately converted into mechanical and heat energy. Thus, in ecological system, the energy is neither created nor destroyed but it is converted from one form into another. Thus, when the wood is burned the potential energy present in the molecule off wood equals the kinetic energy released, and heat is evolved to the surroundings. This is exothermic reaction.

Second law of Law of thermodynamics:

The second law of thermodynamics states that processes involving energy transformation will not occur spontaneously unless there is degradation of energy from a non-random to a random form. In other words, the disorder (entropy) in the universe is constantly increasing and that during energy conservation, an energy transformation will spontaneously occur unless there is degradation of energy from a concentrated form into a dispersed form. For example, in man-made machines (closed systems), heat is the simplest and most recognizable medium of energy transfer. The outcome of this law is very significant in biological system. But in biological systems, energy transfer is not a useful medium, as the living systems are fundamentally isothermal and there

is no significant variation in temperature between different cells in the organism or between various cells in a tissue of the organism.