

Quadrant II – Transcript and Related Materials

Programme: First Year BA/BSc/BCom

Subject: Geography

Course Code: GEG 103

Course Title: Fundamentals of Ecology

Unit: III Functional Aspects of Ecosystem

Module Name: Energy flow in ecosystem: Laws of Thermodynamics

Module No: 18

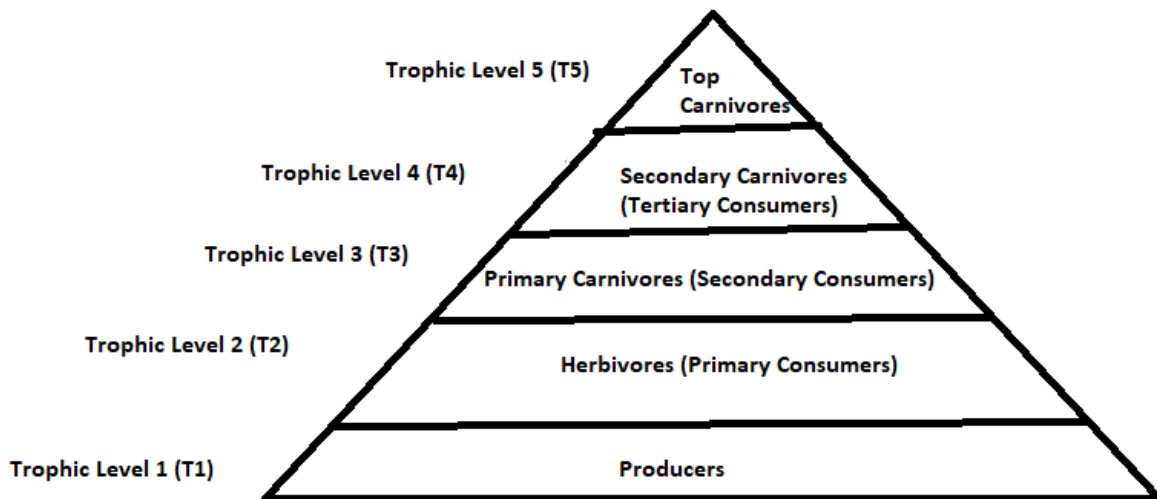
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Notes

- The functioning of ecosystems depends on the flow of energy through matter.
- The source of energy required by all living organisms is the chemical energy of their food.
- The chemical energy is obtained by the conversion of the radiant energy of sun.
- The radiant energy is in the form of electromagnetic waves which are released from the sun.
- Sun is the original and ultimate source of all energy. The sun continuously radiates an enormous amount of energy to the earth.
- Energy is converted into chemical form by the producers.
- The chemical energy stored in the living organisms is converted into potential energy from there the energy passes from one trophic level to the next through food.

Energy Pathways

- There is a unidirectional flow of energy in the biosphere.
- The energy enters the living components from the non-living environments through photosynthesis and is released as heat and lost to the environment.
- The flow of energy is unidirectional because the energy lost as heat from the living organisms of food chains cannot be reused by the plants in photosynthesis.
- Energy is converted from one form to another and there is loss of energy during the food chain.
- A lot of energy remains unutilized and is lost to the surroundings.
- It should be noted that the energy transfers during food chains in the biosphere obey the laws of thermodynamics.
- The pathways along which the energy flows in an ecosystem can be studied in two ways:
 - The energy relationship can be studied between organisms and the community by way of food chains, food webs and trophic levels.
 - The flow of energy in an ecosystem can be studied in terms of number of organisms, biomass of organisms and energy content of organisms at each trophic level.
- The producers and consumers in the ecosystem can be arranged into different feeding groups and are known as trophic level or the feeding level.
- The producers (plants) represent the first trophic level.
- Herbivores (primary consumers) present the second trophic level.
- Primary carnivores (secondary consumers) represent the third trophic level. Secondary carnivores (tertiary consumers) represent the fourth trophic level. Top carnivores represent the last level.



Laws of Thermodynamics

- The flow of energy in the ecosystem is governed by two basic laws of thermodynamics:-

1) The first law of Thermodynamics

- It states that the amount of energy in the universe is constant.
- Energy may be transferred from one type to another, but it can neither be created nor be destroyed.
- Light energy can be neither created nor destroyed as it passes through the atmosphere.
- It may, however, be transformed into another type of energy, such as chemical energy or heat energy.
- It is frequently transformed into an unusable form like heat and is thus lost to the ecosystem, but energy itself has not been destroyed.

2) The second law of Thermodynamics

- The second law of thermodynamics says that the energy transformation is never completely efficient.
- When energy is changed from one form to another, for example from light energy to chemical energy in photosynthesis, some of the energy is converted into unusable heat.
- Therefore, 100% transformation of energy from one form to the other or transfer from one organism to the other is not possible.
- It is always accompanied by some dispersion or loss of energy in the form of heat.
- In other words, less energy will be available at successive trophic levels in an ecosystem.
- These two laws of thermodynamics function in ecosystem or biosphere as they do throughout the physical world.
- The 10 % rule states that only about 10% of energy stored as biomass in a trophic level is passed from one level to the next.
- So if producers have 10,000 J of energy stored through photosynthesis, then only 1000 J is passed on to primary consumers. This means that 90% is lost at each trophic level.