S. S. College, Jehanabad

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ENERGY FLOW AND TROPHIC LEVEL IN ECOSYSTEM

Energy is essential for every organism for their day to day activity and survival. Therefore, energy can be defined as a capacity to do work. The energy in nature exists in two forms namely potential energy and kinetic energy. **Potential energy** is a form of energy which has potential for a reaction, though it exists in stored form. In other words, potential energy is an energy due to position and is stored that can be used to do work. On the other hand, **kinetic energy** is the energy of movement such as motion of molecules which is also known as free energy. It results in work performance at the expense of potential energy i.e. potential energy is converted to kinetic energy and this conversion involves the imparting of motion.

In the biological system, both form of energy are important. Except deep sea or abyssopelagic zone or abyssal zone[1], an ultimate source of energy is the Sun. All producers absorb energy in the form of Sun rays[2] (kinetic energy) and store this energy in the form of chemical compound or chemical energy. However, some chemosynthesizing bacteria create usable chemical energy from unusable chemical energy. Next to producers, potential energy is more important in the biological system than the kinetic energy because potential energy is the stored form of energy and is readily available in the form of chemical energy. The chemical energy in the form of food produced by the producers is passed to consumers, scavengers, and decomposers to sustain continuous energy flow.

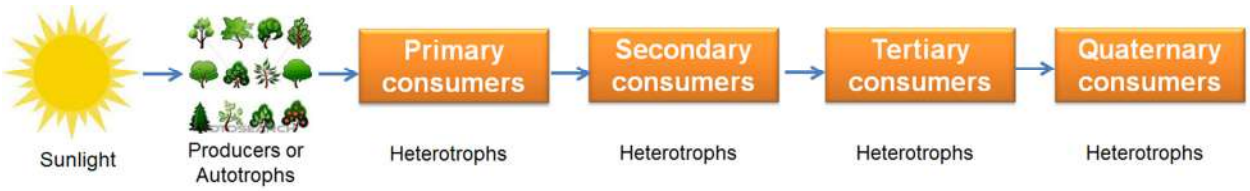
Energy flow in ecosystem

Energy flow in an ecosystem is also an unidirectional flow. Here, radiant energy emanated from the Sun as sunlight in the form of electromagnetic waves is absorbed of chloroplasts present in green vegetation and fixed this energy in the form of potential chemical energy or food that can be broken down to provide energy. These organisms, which utilize inorganic substances and light energy to produce organic molecules that is later available in the form of food, are called as **autotrophs** (producing food itself). While, those organisms, which cannot obtain energy directly from sunlight or cannot produce potential chemical energy or food from abiotic sources but exclusively depend on potential chemical energy or food produced by autotrophs are called **heterotrophs**. Those organisms which obtain energy from living organisms are called **consumers** and those which obtain energy from dead organisms are called **decomposers** or **scavengers**. Consumers are further classified as primary consumer, secondary consumer, tertiary consumer, and quaternary consumers. ***Primary consumers*** are those organism which are completely dependent on producers or autotrophs such as herbivores, while ***secondary consumers*** are those organisms or consumers which are fed on primary consumers or herbivore organisms. Secondary consumers are also known as **primary carnivores** as they feed on animals that are dependent on producers. Likewise, ***tertiary consumers***, also called as **secondary carnivores**, are those organisms which are fed on secondary consumers or primary carnivores, and ***quaternary consumers,*** also called as tertiary carnivores, are those consumers which are fed

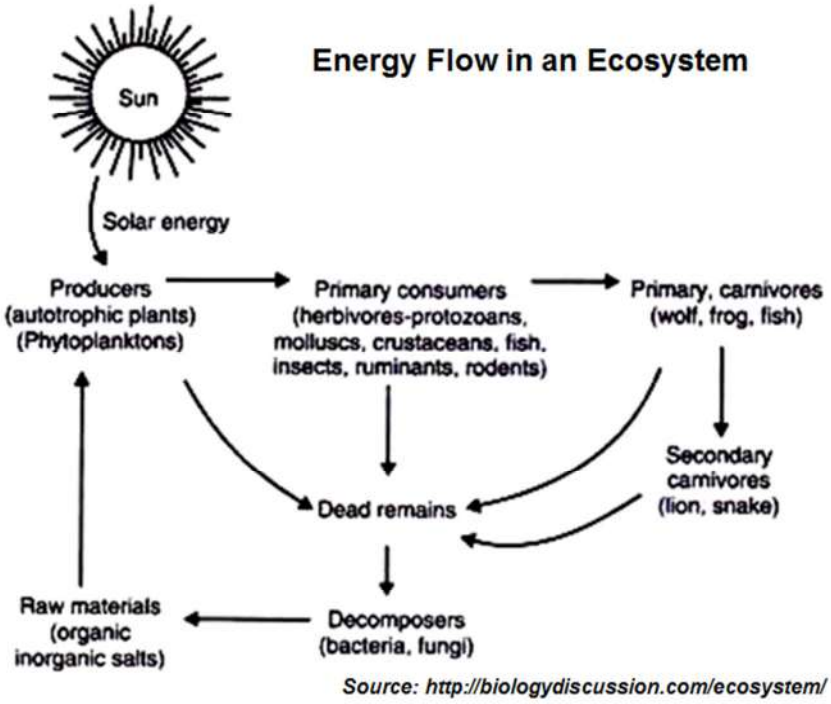
[1] Abyssal zone is a deep sea zone that remains in perpetual darkness at depths of 3000 to 6000 meters (9800 – 19700ft. The word is derived from Grreek word *'Abyss'*, which means bottomless. It makes up over 83% of the ocean and covers 60% of the earth.

[2] ~ 57% of sun's energy or sunlight is absorbed in the atmosphere and scattered in the space; ~35% of this energy is spent to heat water and land areas and to evaporate water; ~8% of sunlight is transmitted; and only ~2% (0.5 to 3.5%) sunlight falls on green vegetation, which is utilized for energy conversion into food (chemical energy).

on tertiary consumers or secondary carnivores. Thus, the flow of energy in an ecosystem can be drawn as follows;



However, one more class of organisms are there which fed on all organism after their decay, as described, such organisms are called decomposers. Decomposers and scavengers have many types of organisms that depend upon all these level of organisms from producers to tertiary and quaternary consumers. All types of decomposers are fungi, bacteria, snails and slugs, which get the nutrients they need by eating dead and decaying materials. These organisms keep ecosystems healthy by ensuring plants get the nutrients they need to survive. Some decomposers are classified as scavengers which eat dead animals and plants, breaking the dead material into smaller pieces as they eat. When scavengers finish eating, other decomposers feed on what is left of the dead organism. Clams, earthworms and fresh water shrimps are all classified as scavengers.



The energy conversion or energy flow is purely based on two important **Laws of Thermodynamics** named as first law of thermodynamics and second law of thermodynamics, which are as follows;

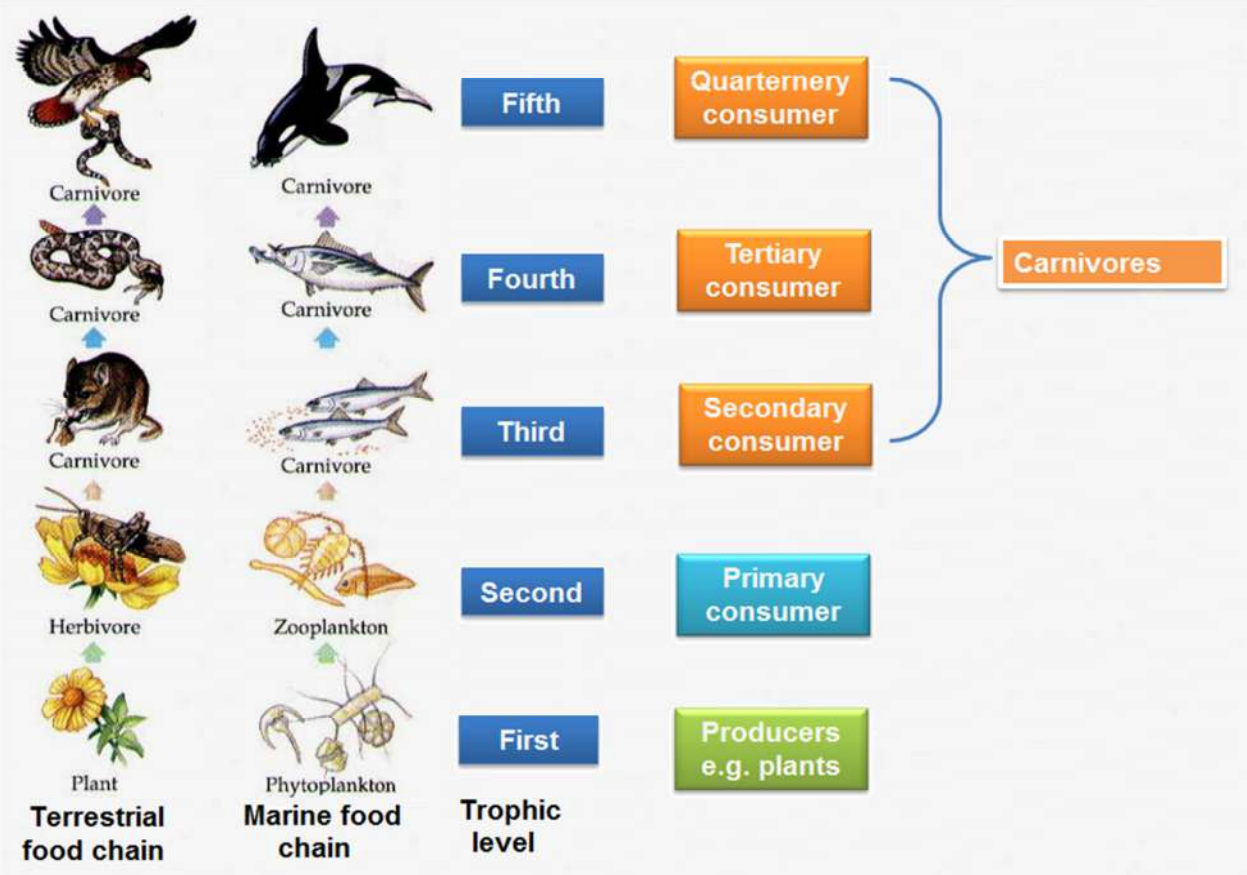
First law of thermodynamics: It states the amount of energy in the universe is constant. It may change from one form to another, but it can neither be created nor destroyed. Light energy, too, can be neither created nor destroyed as it passes through the atmosphere. It may however, be transformed into another type of energy, such as chemical energy or heat energy. These forms of energy cannot be transformed into electromagnetic radiation.

Second law of thermodynamics: It states that non-random energy (mechanical, chemical, radiant energy) cannot be changed without some degradation into heat energy. The conversion

of energy from one form to another takes place in such a way that a part of energy dissipated in the form of heat energy. In this way, after transformation the capacity of energy to perform work is decreased. Thus, energy flows from higher to lower level.

Trophic levels

In ecology, the trophic level is the position that an organism occupies in a food chain. The producers and consumers, both, in ecosystem can be arranged into several feeding groups, each known as a separate trophic level or feeding level (better to be called as trophic level). Since, energy flows through an ecosystem in only one direction, therefore the energy from a trophic level is transmitted through immediate next trophic level and so forth. In any given ecosystem, producers represent the ***first trophic level***, herbivores or primary consumers represent the ***second trophic level***, secondary consumers or primary carnivores represent the ***third trophic level***, tertiary consumers or secondary carnivores represent the ***fourth trophic level***, quaternary consumers or tertiary carnivores represent the ***fifth trophic level***, which may be last trophic level or top carnivores as shown in figure below. Number of organisms in each trophic level is less than the previous ones i.e. upon going to higher level in a food chain, number of organisms decrease.



Most of the energy at a trophic level (~90%), is used at that trophic level for the growth, locomotion, heating themselves, and reproduction. Therefore, organisms at the second trophic

level have only about 10% as much energy available to them as do organisms at the first trophic level. Animals at the third level have only 10% as much energy available to them as those at the second level and the so on.

References

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