S. S. College, Jehanabad

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Topic: Energy Flow in Ecosystem - Food Chain

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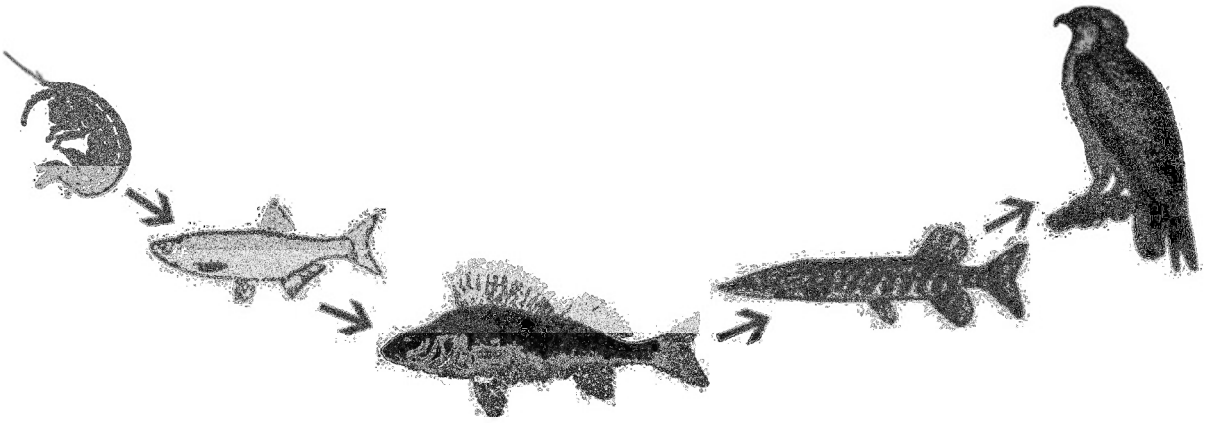
ENERGY FLOW IN ECOSYSTEM - FOOD CHAIN

The sequential chain of eating and being eaten in an ecosystem is called as a food chain. It is the process which determines how energy moves from one organism to another within the system. In a food chain, energy is transferred from one organism to another i.e. flow of energy from plant to animal and from animal to animal. Ideally, this transfer or flow of energy from the sun to green plants to herbivores to carnivores should be 100 per cent efficient. But in reality, this does not happen, because at each link in a food chain, 80 to 90 per cent of the energy transferred is utilized in growth, development, reproduction, and other activities, and some part lost as heat (second law of thermodynamics). It is because of this loss that fewer individuals are found at each successive level of the food chain (e.g. fewer carnivores than herbivores).

Food chains: Food chains show the flow of energy from plant to animal and from animal to animal. Plants are called producers because they "produce" food in the form of carbohydrates during photosynthesis. Consumers eat plants and other organisms. Each step in a food chain is called a trophic level as described above. In the food chain, all organisms eat at only one trophic level.

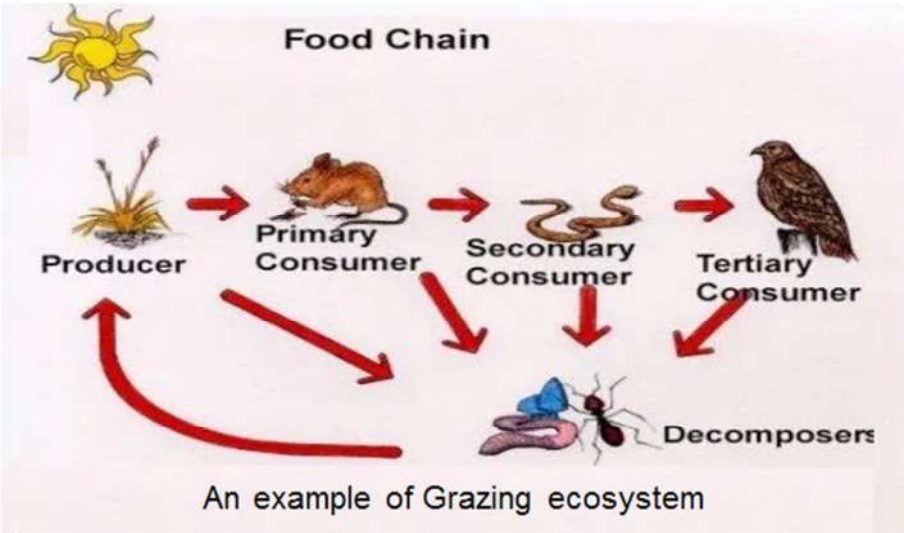
In an ecosystem, green plants (phytoplankton in planktonic zone of aquatic as well as marine ecosystem) are able to trap in solar energy and convert it into chemical energy. The chemical energy is locked up in the various organic compounds, such as carbohydrates, fats and proteins, present in the green plants. Since, virtually all other living organism depend upon green plants for their energy, the efficiency of plants in any given area in capturing sun energy sets the upper limit to long-term energy flow and biological activity in the community.



A simple food chain in a lake. The producers, algae, are not shown.

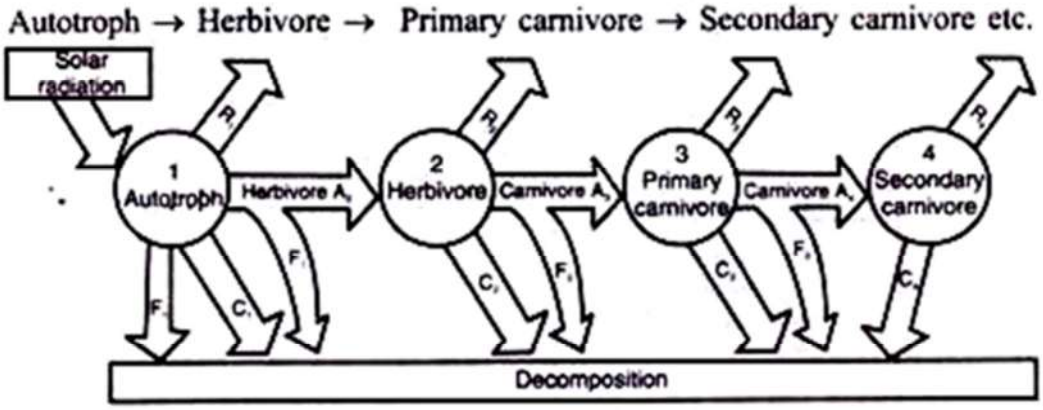
Above figure depicts the simple food chain in a lake, where algae or phytoplankton found in the pelagic zone captures light rays and produces food with the help of chloroplast. The phytoplanktons are eaten up zooplankton which include Cladocera and Copepodds (both are micro-crustaceans), rotifers and protozoans. These zooplanktons are eaten by fishes which are grouped under secondary consumer, secondary consumers are eaten by tertiary consumer, fishes of tertiary consumers are eaten by fishes of quaternary consumers or tertiary carnivore fishes, which are finally eaten by a top consumers or top carnivores, or fish eating birds. Men are also a

part of many terrestrial food chains. The food chains are of mainly three types: grazing food chain, parasitic food chain, and saprophytic food chain that are described below:



An example of Grazing ecosystem

Grazing food chain: The grazing food chain starts from green plants and from autotrophs and it goes to herbivores (primary consumers) to primary carnivores (secondary consumers) and then to secondary carnivores (tertiary consumers) and so on. The above figure is also an example of grazing ecosystem. The gross production of a green plant in an ecosystem may have three fates – it may be oxidized in respiration, it may be eaten by herbivorous animals and after the death and decay of producers it may be utilized by decomposers and converters and finally released into the environment. In herbivores the assimilated food can be stored as carbohydrates, proteins and fats, and transformed into much more complex organic molecules.

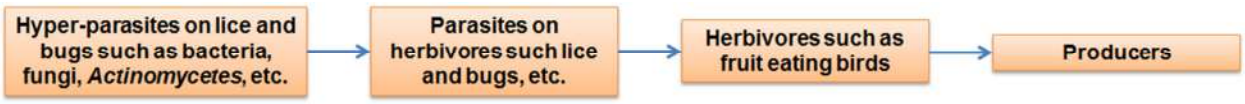


Diagrammatic representation of a grazing food chain showing input and losses of energy at each trophic level. Trophic levels are numbered and used as subscripts to letters indicating energy transfer. A—assimilation of food by the organisms at the trophic level; F—energy lost in the form of faeces and other excretory products; C—energy lost through decay; and R—energy lost to respiration. ***Source: https://www.biologydiscussion.com/ecosystem/***

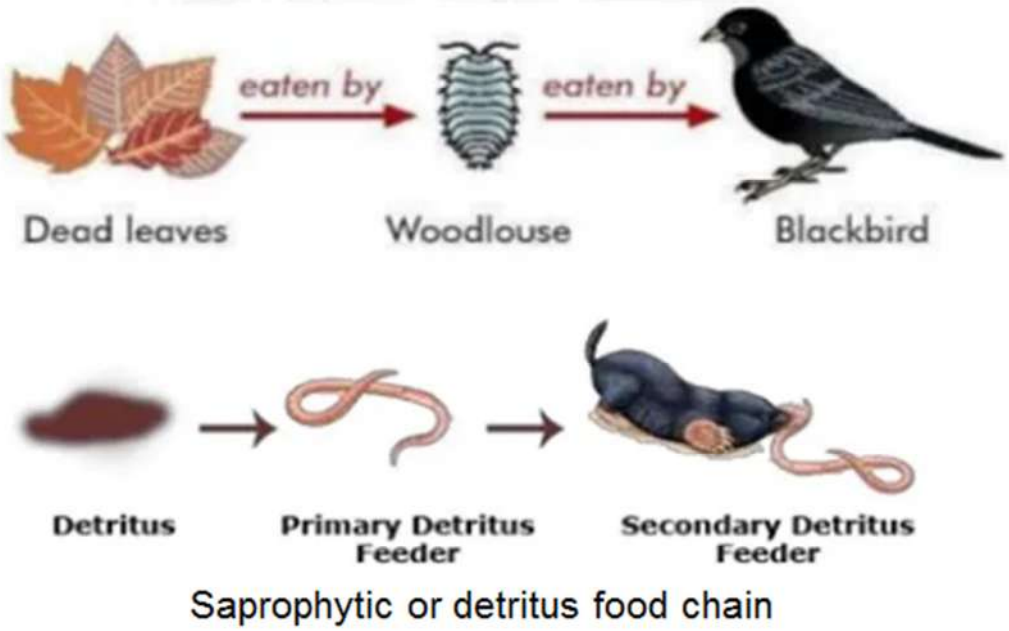
The energy for these transformations is supplied through respiration. As in autotrophs, the energy in herbivores also meets three routes respiration, decay of organic matter by microbes and consumption by the carnivores. Likewise, when the secondary carnivores or tertiary consumers eat primary carnivores, the total energy assimilated by primary carnivores or gross tertiary production follows the same course and its disposition into respiration, decay and further consumption by other carnivores is entirely similar to that of herbivores. Thus, it is obvious that

much of the energy flow in the grazing food chain can be described in terms of trophic levels as outlined in blow figure:

Parasitic food chain: It goes from large organisms to smaller ones without killing as in the case of predator. Hence, the larger animals are considered to be the hosts and the smaller animals which fulfill their nutritional requirements from the hosts are considered as parasites as given in the figure below.



Saprophytic food chain: This type of food chain is also known as detritus food chain. Detritus is the dead organic remains including metabolic wastes and exudates derived from grazing food chains. The energy contained in detritus or dead remain of an organism is not lost in ecosystem as a whole, rather it serves as a source of energy for a group of organisms called **detritivores** that are separate from the grazing food chain. The food chain so formed is called detritus food chain. In detritus food chain, the energy flow remains as a continuous passage rather than as a stepwise flow between discrete entities. As shown in figure, the organisms in the detritus food chain are algae, fungi, bacteria, slime moulds, actinomycetes, protozoa, etc. They ingest pieces of partially decomposed organic matter, digest them partially and after extracting some of the chemical energy, excrete the remainder in the form of simpler organic molecules humus (comparatively stable and becomes an important part of the soil), and inorganic molecules such as carbon dioxide, water and other minerals.



Saprophytic or detritus food chain

Relevance of the loss of energy at each trophic level is that each trophic level can support relatively fewer organisms and therefore top organisms in the food chain have a very large range in which to hunt so that it can get enough energy to live. Further, food chain in most of the

ecosystem can support only four or five trophic levels with an exception of food chain of ocean, which is a comparatively more stable ecosystem and therefore have longer food chains.

References

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