B. Sc. Part I PAPER – III: ELEMENTS OF CELL BIOLOGY, EVOLUTION AND ECOLOGY,

Food chain and food web

Prof. R.K Upadhyay

Food chain refers to the sequence of events in an ecosystem, where one organism eats another and then is eaten by another organism. Food chains were first introduced by the Arab scientist and philosopher Al-Jahiz in the 10th century and later popularized in a book published in 1927 by Charles Elton, which also introduced the food web concept.

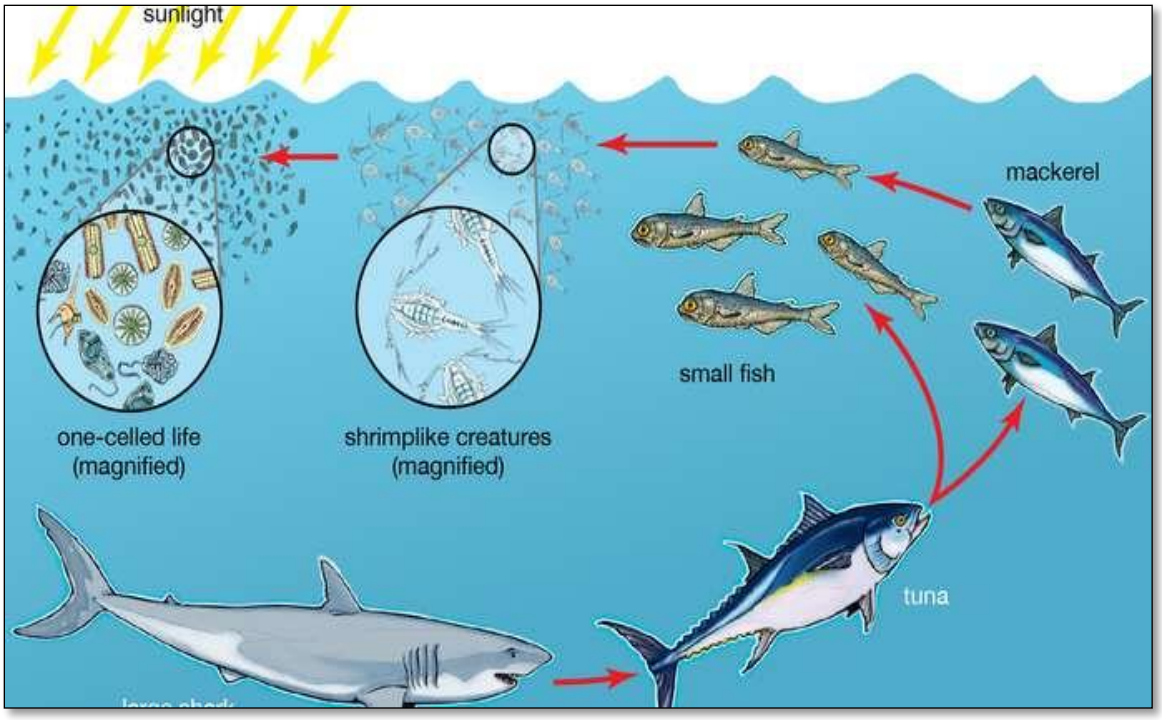
A *food chain* describes how different organisms eat each other, starting out with a plant and ending with an animal.

A food chain is a pathway that represents the exchange of energy from one organism to another. In other words, it is the chronological order of who eats whom in a biological community.

Food chains go hand-in-hand with food webs, though there are differences between the two. While a food chain is a single pathway of energy transfer, a food web shows all of the different relationships or possible energy transfers between a selected group of species.

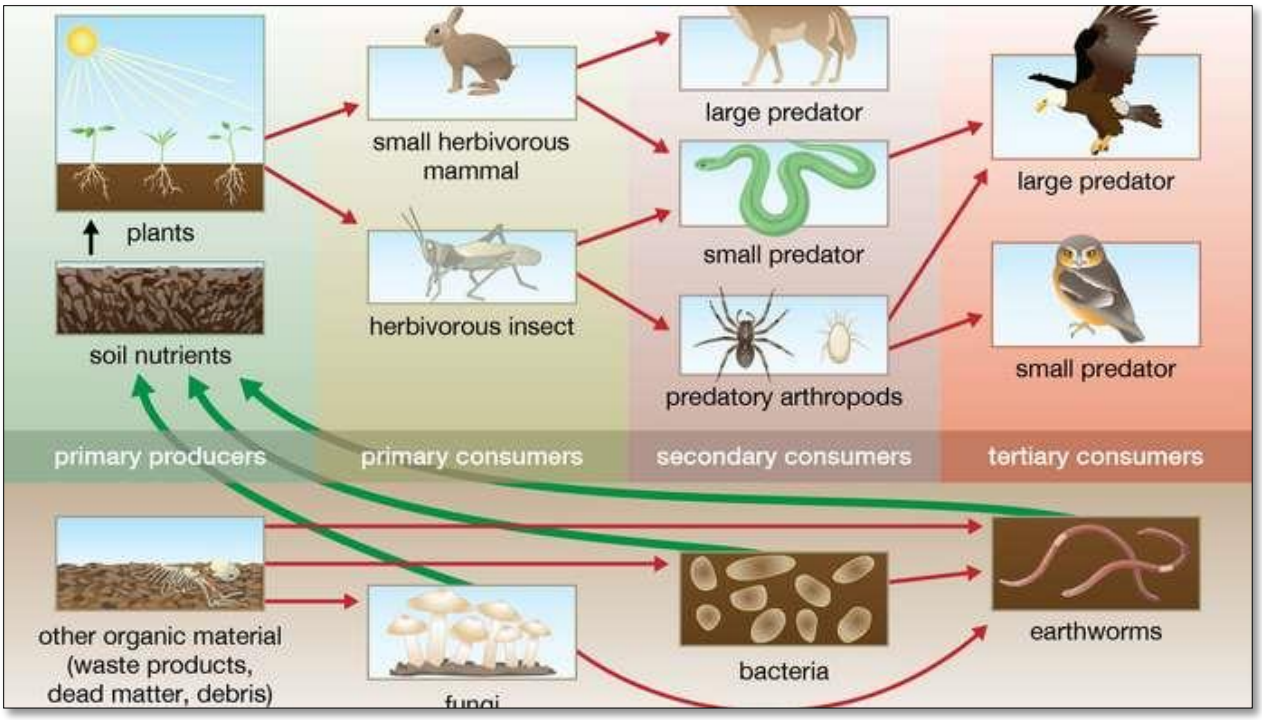
Food chain, in ecology, the sequence of transfers of matter and energy in the form of food from organism to organism. Food chains intertwine locally into a food web because most organisms consume more than one type of animal or plant. Plants, which convert solar energy to food by photosynthesis, are the primary food source. In a predator chain, a plant-eating animal is eaten by a flesh-eating animal. In a parasite chain, a smaller organism consumes part of a larger host and may itself be parasitized by even smaller organisms. In a saprophytic chain, microorganisms live on dead organic matter.

Application: A food chain models the movement of energy in an ecosystem (a form of environmental system).

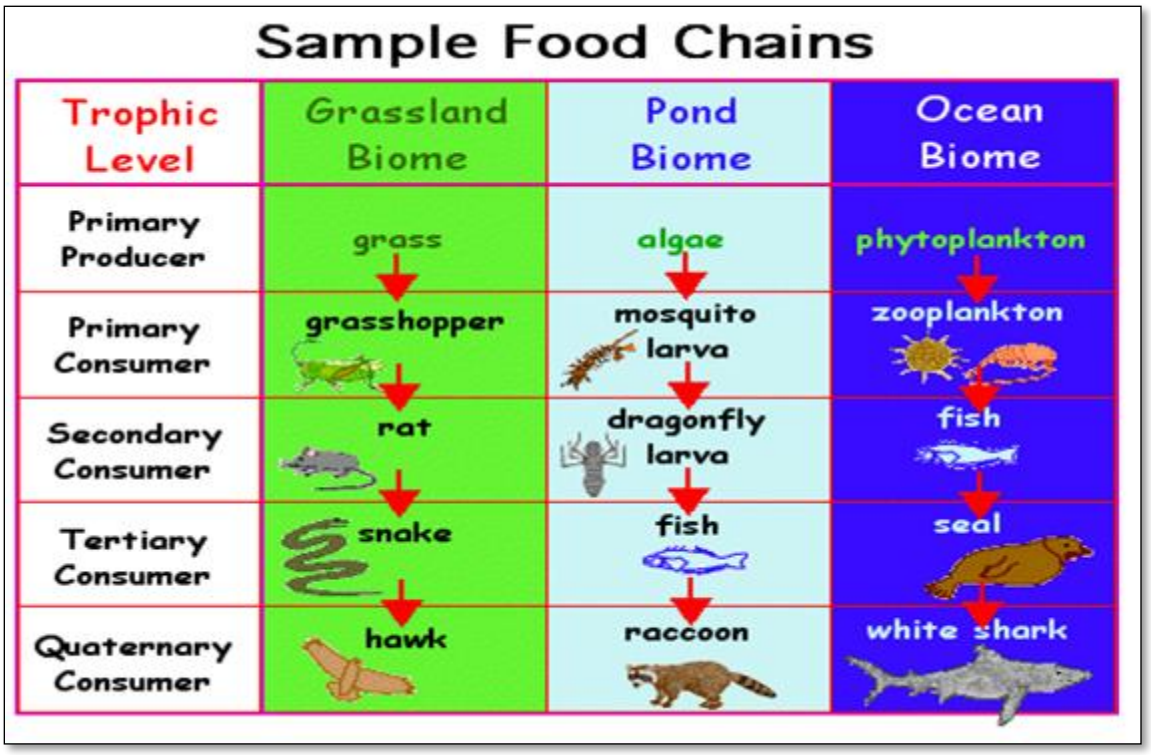


Diatoms and other phytoplankton form the foundations of ocean food chains. Shrimplike krill consume the phytoplankton, and small fishes eat the krill. At the top of the food chain, dining on these smaller fishes, are larger, predatory fishes.

Because energy, in the form of heat, is lost at each step, or trophic level, chains do not normally encompass more than four or five trophic levels. People can increase the total food supply by cutting out one step in the food chain: instead of consuming animals that eat cereal grains, the people themselves consume the grains. Because the food chain is made shorter, the total amount of energy available to the final consumers is increased.



The terrestrial food chain featuring producers, consumers, and decomposers.



Sample Food Chains

Trophic Level	Grassland Biome	Pond Biome	Ocean Biome
Primary Producer	grass	algae	phytoplankton
Primary Consumer	grasshopper	mosquito larva	zooplankton
Secondary Consumer	rat	dragonfly larva	fish
Tertiary Consumer	snake	fish	seal
Quaternary Consumer	hawk	raccoon	white shark

A Food chain is a series of organisms that transfer food between the trophic levels of an ecosystem using only one species at each level…a simple chain.

- **The arrows represent the flow of energy from one organism to the next.**
- **The arrow points toward the organism doing the 'eating'.**

Ecosystems are not as simple as shown and not often explained by a single food chain… Food webs more accurately show the network of food chains representing the feeding relationships among organisms in an ecosystem.

- **Most organisms feed on more than one type of organism at different trophic levels.**

A food chain is a linear network of links in a food web starting from producer organisms (such as grass or trees which use radiation from the Sun to make their food) and ending at apex predator species (like grizzly bears or killer whales), detritivores (like earthworms or woodlice), or decomposer species (such as fungi or bacteria). A food chain also shows how organisms are related to each other by the food they eat. Each level of a food chain represents a different trophic level. A food chain differs from a food web because the complex network of different animals' feeding relations are aggregated and the chain only follows a direct, linear pathway of one animal at a time. Natural interconnections between food chains make it a food web.

A common metric used to quantify food web trophic structure is food chain length. In its simplest form, the length of a chain is the number of links between a trophic consumer and the base of the web. The mean chain length of an entire web is the arithmetic average of the lengths of all chains in the food web. The food chain is an energy source diagram. The food chain begins with a producer, which is eaten by a primary consumer. The primary consumer may be eaten by a secondary consumer, which in turn may be consumed by a tertiary consumer. For example, a food chain might start with a green plant as the producer, which is eaten by a snail, the primary consumer. The snail might then be the prey of a secondary consumer such as a frog, which itself may be eaten by a tertiary consumer such as a snake.

Food chains are very important for the survival of most species. When only one element is removed from the food chain it can result in extinction of a species in some cases. The foundation of the food chain consists of primary producers. Primary producers, or autotrophs, utilize energy derived from either sunlight or inorganic chemical compounds to create complex organic compounds, whereas species at higher trophic levels cannot and so must consume producers or other life that itself consumes producers. Because the sun's light is necessary for photosynthesis, most life could not exist if the sun disappeared. Even so, it has recently been discovered that there are some forms of life, chemotrophs, that appear to gain all their metabolic energy from chemosynthesis driven by hydrothermal vents, thus showing that some life may not require solar energy to thrive.

Decomposers, which feed on dead animals, break down the organic compounds into simple nutrients that are returned to the soil. These are the simple nutrients that plants require to

create organic compounds. It is estimated that there are more than 100,000 different decomposers in existence.

Many food webs have a keystone species. A keystone species is a species that has a large impact on the surrounding environment and can directly affect the food chain. If this keystone species dies off it can set the entire food chain off balance. Keystone species keep herbivores from depleting all of the foliage in their environment and preventing mass extinction.

Food chain length

The length of a food chain is a continuous variable providing a measure of the passage of energy and an index of ecological structure that increases through the linkages from the lowest to the highest trophic (feeding) levels.

Food chains are directional paths of trophic energy or, equivalently, sequences of links that start with basal species, such as producers or fine organic matter, and end with consumer organisms.

The efficiency of a food chain depends on the energy first consumed by the primary producers.[13] The primary consumer gets its energy from the producer. The tertiary consumer is the 3rd consumer, it is placed at number four in the food chain. Producer → Primary Consumer → Secondary Consumer → Tertiary Consumer.

Grazing food chain

Grazing food chain is a type of food chain in which energy at the lowest trophic level is acquired via photosynthesis. The grazing food chain begins with producers like green plants, who create their own food through the process of photosynthesis and later move from herbivores to carnivores.

Detritus food chain

Detritus food chain is the type of food chain that starts with dead organic materials. The dead organic substances are decomposed by microorganisms. The organisms that feed on dead organic matter or detritus, are known as detritivores or decomposers. These detritivores are later eaten by predators.

Food web:

A food web (or food cycle) is the natural interconnection of food chains and a graphical representation (usually an image) of what-eats-what in an ecological community. Another name for food web is consumer-resource system. Ecologists can broadly lump all life forms into one of two categories called trophic levels: 1) the autotrophs, and 2) the heterotrophs.

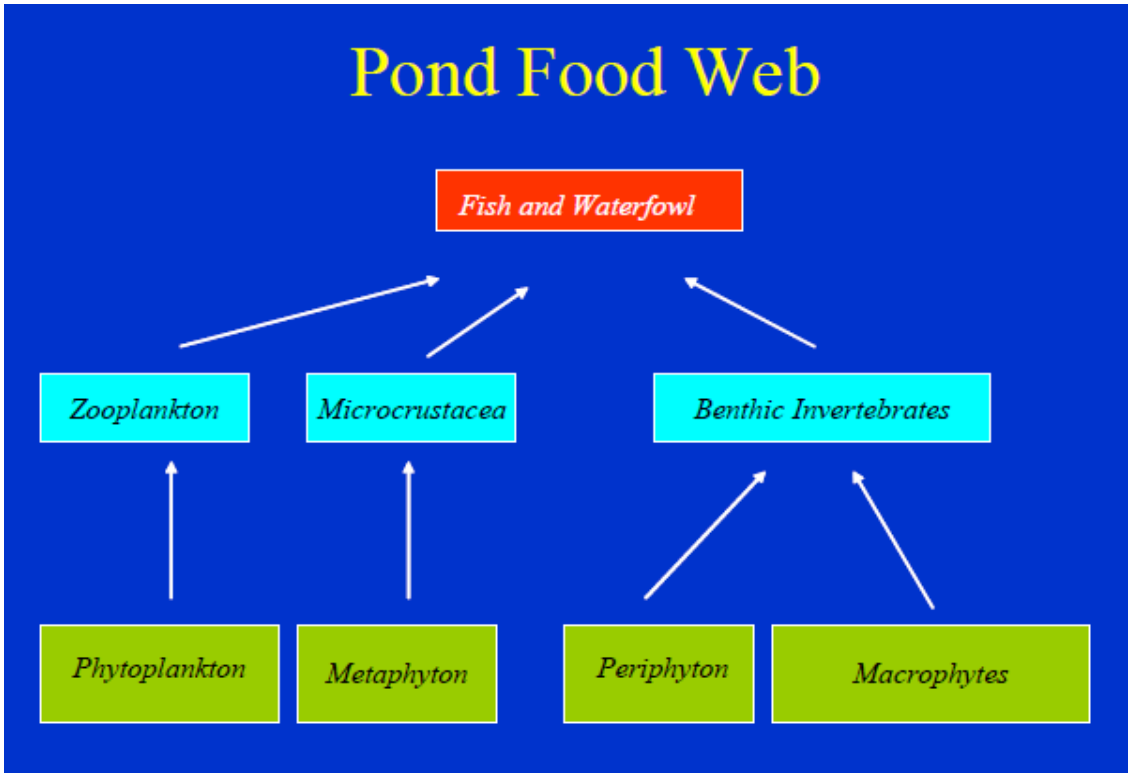
Charles Elton pioneered the concept of food cycles, food chains, and food size in his classical 1927 book "Animal Ecology"; Elton's 'food cycle' was replaced by 'food web' in a subsequent ecological text.

Food webs are limited representations of real ecosystems as they necessarily aggregate many species into trophic species, which are functional groups of species that have the same predators and prey in a food web. Ecologists use these simplifications in quantitative (or mathematical representation) models of trophic or consumer-resource systems dynamics.

Food webs are the road-maps through Darwin's famous 'entangled bank' and have a long history in ecology. Like maps of unfamiliar ground, food webs appear bewilderingly complex. They were often published to make just that point. Yet recent studies have shown that food webs from a wide range of terrestrial, freshwater, and marine communities share a remarkable list of patterns.

There are different kinds or categories of food webs:

- **Source web** - one or more node(s), all of their predators, all the food these predators eat, and so on.
- **Sink web** - one or more node(s), all of their prey, all the food that these prey eat, and so on.
- **Community (or connectedness) web** - a group of nodes and all the connections of who eats whom.
- **Energy flow web** - quantified fluxes of energy between nodes along links between a resource and a consumer.[4][40]
- **Paleoecological web** - a web that reconstructs ecosystems from the fossil record.[58]
- **Functional web** - emphasizes the functional significance of certain connections having strong interaction strength and greater bearing on community organization, more so than energy flow pathways


Pond Food Web
Fish and Waterfowl
Zooplankton
Microcrustacea
Benthic Invertebrates
Phytoplankton
Metaphyton
Periphyton
Macrophytes

Food Chain	Food Web
1. It is a straight single pathway through which food energy travels in the ecosystems.	1. It consists of number of interconnected food chain through which food energy passes in the ecosystems.
2. Members of higher trophic level feed upon a single type of organisms of lower trophic level.	2. Members of higher trophic level can feed upon a number of alternative organisms of the lower trophic level.
3. Presence of separate or isolated food chains adds to the instability of the ecosystem.	3. Presence of food webs increases the stability of the ecosystem.
4. It does not add to adaptability and competitiveness of the organisms.	4. Food webs increase adaptability and competitiveness of the organisms.