

Energy flow, Food chain, Food web and ecological Pyramid

All ecosystems must have a source of energy (usually the sun) because all organism functions such as growth and reproduction require energy. Energy moves through the ecosystem by a series of events that link organisms together.

Plants have green pigments, called chlorophyll which captures energy from the sun (solar energy) to split carbon dioxide atoms and then combine the carbon atoms with oxygen and hydrogen (photosynthesis) to make sugars (food). Solar energy is transformed into chemical energy stored in the bonds that hold the atoms of the sugar molecules. Oxygen also is released. Plants are essential to all ecosystems because they produce oxygen and food needed by all other living things.

Photosynthesis

Carbon dioxide + water + sunlight + nutrients → Simple sugar + oxygen

Some sugars produced during photosynthesis are broken down during respiration to release energy needed by the plant for growth and reproduction. Others are used to make "building blocks" that are combined to make plant cells, hence plant parts.

Respiration

Simple sugar (food) + oxygen → Carbon dioxide + water + energy (heat)

Animals that eat plants (herbivores) use them to make animal parts or burn them to produce energy for their cell functions. Any compounds not used immediately are combined and stored as fats. Tissues of animals eaten by other animals (predators/carnivores) are broken down and re-combined into new parts for that animal, and so on. Thus, all animals depend on plants for food.

Trophic levels

The different feeding levels in the food chain are called trophic levels. Food chains comprised of many feeding or nourishing levels, and each level is called trophic level. The first trophic level in the food chain is called primary producers, the second trophic level is the primary consumers (herbivores), and the third level is occupied by the primary carnivores. The number of trophic levels in a food chain is always restricted to 3 to 5. Lower the number of trophic levels, higher the transfer of energy to the top level organisms in the food chain. The energy transfer will be very less to the top predator, if the food chain is having more than three levels of trophic tiers.

Energy Flow

The transfer of energy from one trophic level to another is called energy flow. This flow of energy is always unidirectional and never returns back, like nutrients, which cycles in the

ecosystem. So, energy can be utilised once in the ecosystem and otherwise it will go as waste heat.

Through these series of steps of eating and being eaten, energy flows from one trophic level to another. Green plants or other photosynthesizing organisms use light energy from the sun to manufacture carbohydrates for their own needs. Most of this chemical energy is processed in metabolism and dissipated as heat in respiration. Plants convert the remaining energy to biomass. Ultimately, this material, which is stored energy, is transferred to the second trophic level, which comprises grazing herbivores, decomposers, and detrital feeders. Most of the energy assimilated at the second trophic level is again lost as heat in respiration; a fraction becomes new biomass. Organisms in each trophic level pass on as biomass with much less energy than they receive. Thus, the more steps between producer and final consumer, the less energy remains available. Seldom are there more than four links, or five levels, in a food web. Eventually, all energy flowing through the trophic levels is dissipated as heat. The process whereby energy loses its capacity to do work is called entropy.

Food chain

The biotic components of any ecosystem are linked with each other by food. This food relationship with other organisms is termed a food chain. In any ecosystem, the primary producers form the food source for the primary consumers or herbivores, which will form food source to the secondary consumers or carnivores. The sequence of eaters being eaten is called food chain. A simple food chain may start with microscopic green algae. Microscopic zooplankton will serve as food for the small fishes.

Primary producers	Primary consumers	Secondary consumers
(Phytoplankton and macroplants)	(Zooplankton and herbivorous fishes)	(Small fishes and predatory fishes)

In a simple food chain, there are more than two trophic levels and the energy is transferred from one level to another. This transfer of energy from one trophic level to another is termed energy flow. The flow of energy in the food chain is unidirectional and never flows back. When the energy is passed on to the next trophic level, the efficiency is lost from one level to another.

Ecological Pyramid

An ecological pyramid (or trophic pyramid) is the graphical representation of the trophic structure such as number, biomass and energy of an ecosystem. The use of this ecological pyramid was first proposed by Charles Sutherland Elton (1927), and hence these ecological pyramids are called Eltonian pyramid. Ecological pyramids begin with producers on the bottom

and proceed through the various trophic levels, the highest of which is on top. There are three types of ecological pyramids, viz. i) pyramid of numbers, ii) pyramid of biomass and iii) pyramid of energy.