

Ecological processes



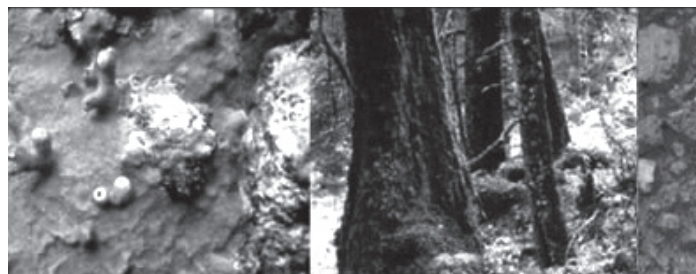
The four fundamental ecological processes of ecosystems are the water cycle, biogeochemical (or nutrient) cycling, energy flow and community dynamics, i.e. how the composition and structure of an ecosystem changes following a disturbance (succession).

Water cycle. Water (H₂O) is the most abundant molecule on Earth. It is the only one that can be found naturally in solid, liquid and gas and is essential to all life on Earth. From the ability to store energy through photosynthesis to the consumption of energy through respiration, the properties of water provide a perfect medium for biological reactions that occur within cells.

The water that evaporates from the ocean with the sun's energy is transported by the circulation of winds around the planet. Upon rising over the contours of the mountains, it cools and becomes rain, providing moisture to rain forests, jungles, grasslands and scrub. It feeds streams, rivers, lakes, and groundwater before eventually returning to the sea. On this long journey, it is absorbed by plants and drunk by animals, which all require water as it constitutes between 55 - 80% of all living things.

- Virtual Centre for Water Information
- Animation of water cycle and watershed management

Nutrient cycles. Chemical elements that make up a living being, such as carbon, oxygen, nitrogen, hydrogen, potassium, calcium, phosphorus, sulphur and many others, are transported between living organisms and non-living components of the planet.



These elements are essential for the structure and function of living organisms. Some will accumulate in them while they are alive and return to the soil and the atmosphere when they die. Drastic changes in the dynamics of these cycles produce pollution, eutrophication (surplus nutrient levels in wetlands) and ultimately global climate change.

Carbon is found in the atmosphere, biosphere, oceans and sediments. Plants take carbon dioxide from the atmosphere and convert it into carbohydrates and, in this form, a large part of global carbon is stored in forests and soil. In the sea, many organisms use carbon to form their external skeletons and shells. Carbon returns to the atmosphere through respiration of organisms, organic decomposition, combustion, and volcanic eruptions. The other chemicals have similar cycles.

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Energy flow. Living organisms require energy to perform the basic functions of growth, reproduction and survival. Plants are primary producers that convert the sun's energy into chemical energy through photosynthesis. First, the molecule of chlorophyll absorbs energy from light and splits water molecules into hydrogen and oxygen. Secondly, carbon dioxide is converted into carbohydrates (sugars), i.e. larger molecules composed of carbon, hydrogen and oxygen. Herbivores, as secondary consumers, feed on the plants and derive nutrients and energy from them. These are in turn passed on to carnivores and decomposers. The flow of energy through living things is called a trophic chain (from the Greek *trophē*, food), or food chain, and each level passed along the chain is called a trophic level.

At each transformation, part of the energy is converted into heat (second law of thermodynamics), so there will always be more primary producers than herbivores and more herbivores than secondary consumers (carnivores), thus forming a trophic pyramid.

In order to use energy, the vast majority of living organisms need to split up the molecules where it is stored. Carbohydrates, on reaction with oxygen, are broken, releasing energy and reforming molecules of carbon dioxide and water. This process is known as respiration. Some organisms can obtain energy directly from inorganic molecules (chemosynthesis).

Succession. Ecosystems are dynamic and their composition and structure changes over time. Periodic disturbances such as fires, hurricanes, droughts, floods, and pests occur and these can substantially alter the grasslands, forests, marshes, mangroves and other communities. Such events are known as disturbance regimes and change from region to region depending on climatic conditions.

Following a disturbance that affects some of the populations, the process of community change to its previous (mature) state is called ecological succession.

When the change of environment has been total, as in the case of an eruption that completely erases the original environment, or when a completely new environment is created, such as in the volcanic islands that rise from the sea, the process is called **primary succession**. When the change has only been partial and some of the original species remain, the process is called **secondary succession**.

The American ecologist Frederic E. Clements (1874-1945) was one of the pioneers in the study of the phenomenon of succession and in the development of the succession theory. Clements suggested that, after a disturbance, vegetation returns to a "climax" state, determined by climate conditions. His compatriot, ecologist Henry Gleason (1882-1975), argued that successional changes were due to the individual responses of species rather than a coordinated change in the vegetation as if it collectively acts as one organism.

Currently, the principal disturbance regime is that constituted by human activity. Logging of forests, systems of shifting cultivation, and other activities transform the successional states of ecosystems.