ThoughtCo.

Nutrients Cycle Through The Environment

by Regina Bailey

Updated September 28, 2018

Nutrient cycling is one of the most important processes that occur in an ecosystem. The nutrient cycle describes the use, movement, and recycling of nutrients in the environment. Valuable elements such as carbon, oxygen, hydrogen, phosphorus, and nitrogen are essential to life and must be recycled in order for organisms to exist. Nutrient cycles are inclusive of both living and non-living components and involve biological, geological, and chemical processes. For this reason, these nutrient circuits are known as biogeochemical cycles.

Biogeochemical Cycles

Biogeochemical cycles can be categorized into two main types: global cycles and local cycles. Elements such as carbon, nitrogen, oxygen, and hydrogen are recycled through abiotic environments including the atmosphere, water, and soil. Since the atmosphere is the main abiotic environment from which these elements are harvested, their cycles are of a global nature. These elements may travel over large distances before they are taken up by biological organisms. The soil is the main abiotic environment for the recycling of elements such as phosphorus, calcium, and potassium. As such, their movement is typically over a local region.

Carbon Cycle

Carbon is essential to all life as it is the main constituent of living organisms. It serves as the backbone component for all organic polymers, including carbohydrates, proteins, and lipids. Carbon compounds, such as carbon dioxide (CO_2) and methane (CH_4), circulate in the atmosphere and influence global climates. Carbon is circulated between living and nonliving components of the ecosystem primarily through the processes of photosynthesis and respiration. Plants and other photosynthetic organisms obtain CO_2 from their environment and use it to build biological materials. Plants, animals, and

decomposers (bacteria and fungi) return CO_2 to the atmosphere through respiration. The movement of carbon through biotic components of the environment is known as the **fast carbon cycle**. It takes considerably less time for carbon to move through the biotic elements of the cycle than it takes for it to move through the abiotic elements. It can take as long as 200 million years for carbon to move through abiotic elements such as rocks, soil, and oceans. Thus, this circulation of carbon is known as the **slow carbon cycle**.

Carbon cycles through the environment as follows:

CO_2 is removed from the atmosphere by photosynthetic organisms (plants, cyanobacteria, etc.) and used to generate organic molecules and build biological mass.

Animals consume the photosynthetic organisms and acquire the carbon stored within the producers.

CO_2 is returned to the atmosphere via respiration in all living organisms.

Decomposers break down dead and decaying organic matter and release CO_2.

Some CO_2 is returned to the atmosphere via the burning of organic matter (forest fires).

CO_2 trapped in rock or fossil fuels can be returned to the atmosphere via erosion, volcanic eruptions, or fossil fuel combustion.

Nitrogen Cycle

Similar to carbon, nitrogen is a necessary component of biological molecules. Some of these molecules include amino acids and nucleic acids. Although nitrogen (N_2) is abundant in the atmosphere, most living organisms can not use nitrogen in this form to synthesize organic compounds. Atmospheric nitrogen must first be fixed, or converted to ammonia (NH_3) by certain bacteria.

Nitrogen cycles through the environment as follows:

Atmospheric nitrogen (N_2) is converted to ammonia (NH_3) by nitrogen-fixing bacteria in aquatic and soil environments. These organisms use nitrogen to synthesise the biological molecules they need to survive.

NH_3 is subsequently converted to nitrite and nitrate by bacteria known as nitrifying bacteria.

Plants obtain nitrogen from the soil by absorbing ammonium (NH4-) and nitrate through their roots. Nitrate and ammonium are used to produce organic compounds.

Nitrogen in its organic form is obtained by animals when they consume plants or animals.

Decomposers return NH3 to the soil by decomposing solid waste and dead or decaying matter.

Nitrifying bacteria convert NH3 to nitrite and nitrate.

Denitrifying bacteria convert nitrite and nitrate to N2, releasing N2 back into the atmosphere.

Other Chemical Cycles

Oxygen and phosphorus are elements that are also essential to biological organisms. The vast majority of atmospheric oxygen (O2) is derived from photosynthesis. Plants and other photosynthetic organisms use CO2, water, and light energy to produce glucose and O2. Glucose is used to synthesize organic molecules, while O2 is released into the atmosphere. Oxygen is removed from the atmosphere through decomposition processes and respiration in living organisms.

Phosphorus is a component of biological molecules such as RNA, DNA, phospholipids, and adenosine triphosphate (ATP). ATP is a high energy molecule produced by the processes of cellular respiration and fermentation. In the phosphorus cycle, phosphorus is circulated mainly through soil, rocks, water, and living organisms. Phosphorus is found organically in the form of the phosphate ion (PO43-). Phosphorus is added to soil and water by runoff resulting from the weathering of rocks that contain phosphates. PO43- is absorbed from the soil by plants and obtained by consumers through the consumption of plants and other animals. Phosphates are added back to the soil through decomposition. Phosphates may also become trapped in sediments in aquatic environments. These phosphate containing sediments form new rocks over time.