Phosphorus Cycle Encyclopedia Article

Phosphorus Cycle

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Phosphorus Cycle

Phosphorus is an essential nutrient needed in large amounts by both plants and animals, and is thus known as a macronutrient. The dry weight of most organisms is comprised of approximately 0.3% phosphorus. It is an essential element in the makeup of bones, teeth, deoxyribonucleic acid (DNA), ribonucleic acid (RNA), adenosine triphosphate (ATP), and even cell membranes. The phosphorus cycle is sedimentary in origin. Unlike the nitrogen and carbon cycles, where the main reservoir is in the atmosphere, the main reservoir for phosphorus is in sediments. There is no gaseous phase for phosphorus, so rainwater contains minimal amounts of this nutrient. The main source of phosphorus in the soil is apatite--a calcium-phosphate mineral. Other sources include guano deposits, which are long-term accumulations of phosphate-rich manure produced by colonies of bats, or migrating fish-eating birds, such as pelicans and cormorants. Considerable environmental damage has resulted from mining these deposits on islands. Weathering of terrestrial deposits slowly releases phosphorus, some of which washes into nearby rivers, lakes, or the ocean. Plants take up phosphorus in the form of phosphate and manufacture organic macromolecules like ATP. Herbivores that graze on plants incorporate these organic chemicals into their tissues, and so on through the other links up the food chain. Phosphate is released to the soil or water by animal excretion. This form of recycling is a significant source of phosphorus in freshwater ecosystems, where it is often low in concentration. When organisms die, bacterial and fungal decomposers mineralize the organic phosphorus to inorganic forms, returning phosphorus to the soil, and the cycle continues.

Phosphorus is a limiting nutrient for plant growth in many soils and most freshwater ecosystems. Excess phosphorus that reaches lakes often leads to eutrophication, sometimes evidenced by dense blue-green algae (Cyanobacteria) blooms. Humans accelerate this process, known as cultural eutrophication, by adding excess fertilizers to residential lawns and farm crops, deforestation, and sewage effluent. Most cities have secondary sewage treatment plants, but these remove only a maximum of 30% of the phosphorus. In some rural areas, wastes from chicken and hog farms washes into nearby rivers and eventually into lakes downstream