**Nutrient cycling**

Ecosystems continually exchange energy and carbon with the wider [environment](https://en.wikipedia.org/wiki/Environment_%28systems%29); mineral nutrients, on the other hand, are mostly cycled back and forth between plants, animals, microbes and the soil. Most nitrogen enters ecosystems through biological [nitrogen fixation](https://en.wikipedia.org/wiki/Nitrogen_fixation), is deposited through precipitation, dust, gases or is applied as [fertilizer](https://en.wikipedia.org/wiki/Fertilizer).[[15]](https://en.wikipedia.org/wiki/Ecosystem#cite_note-Chapin197-16) Since most terrestrial ecosystems are nitrogen-limited, nitrogen cycling is an important control on ecosystem production.[[15]](https://en.wikipedia.org/wiki/Ecosystem#cite_note-Chapin197-16)

Until modern times, nitrogen fixation was the major source of nitrogen for ecosystems. Nitrogen fixing bacteria either live [symbiotically](https://en.wikipedia.org/wiki/Symbiosis) with plants, or live freely in the soil. The energetic cost is high for plants which support nitrogen-fixing symbionts—as much as 25% of GPP when measured in controlled conditions. Many members of the [legume](https://en.wikipedia.org/wiki/Legume) plant family support nitrogen-fixing symbionts. Some [cyanobacteria](https://en.wikipedia.org/wiki/Cyanobacteria) are also capable of nitrogen fixation. These are [phototrophs](https://en.wikipedia.org/wiki/Phototroph), which carry out photosynthesis. Like other nitrogen-fixing bacteria, they can either be free-living or have symbiotic relationships with plants.[[15]](https://en.wikipedia.org/wiki/Ecosystem#cite_note-Chapin197-16) Other sources of nitrogen include [acid deposition](https://en.wikipedia.org/wiki/Acid_deposition) produced through the combustion of [fossil fuels](https://en.wikipedia.org/wiki/Fossil_fuel), [ammonia](https://en.wikipedia.org/wiki/Ammonia) gas which evaporates from agricultural fields which have had fertilizers applied to them, and dust.[[15]](https://en.wikipedia.org/wiki/Ecosystem#cite_note-Chapin197-16) Anthropogenic nitrogen inputs account for about 80% of all nitrogen fluxes in ecosystems.[[15]](https://en.wikipedia.org/wiki/Ecosystem#cite_note-Chapin197-16)

When plant tissues are shed or are eaten, the nitrogen in those tissues becomes available to animals and microbes. Microbial decomposition releases nitrogen compounds from dead organic matter in the soil, where plants, fungi and bacteria compete for it. Some soil bacteria use organic nitrogen-containing compounds as a source of carbon, and release [ammonium](https://en.wikipedia.org/wiki/Ammonium) ions into the soil. This process is known as [nitrogen mineralization](https://en.wikipedia.org/wiki/Ammonification). Others convert ammonium to [nitrite](https://en.wikipedia.org/wiki/Nitrite) and [nitrate](https://en.wikipedia.org/wiki/Nitrate) ions, a process known as [nitrification](https://en.wikipedia.org/wiki/Nitrification). [Nitric oxide](https://en.wikipedia.org/wiki/Nitric_oxide) and [nitrous oxide](https://en.wikipedia.org/wiki/Nitrous_oxide) are also produced during nitrification.[[15]](https://en.wikipedia.org/wiki/Ecosystem#cite_note-Chapin197-16) Under nitrogen-rich and oxygen-poor conditions, nitrates and nitrites are converted to [nitrogen gas](https://en.wikipedia.org/wiki/Nitrogen), a process known as [denitrification](https://en.wikipedia.org/wiki/Denitrification).[[15]](https://en.wikipedia.org/wiki/Ecosystem#cite_note-Chapin197-16)

Other important nutrients include [phosphorus](https://en.wikipedia.org/wiki/Phosphorus), [sulfur](https://en.wikipedia.org/wiki/Sulfur), [calcium](https://en.wikipedia.org/wiki/Calcium), [potassium](https://en.wikipedia.org/wiki/Potassium), [magnesium](https://en.wikipedia.org/wiki/Magnesium) and [manganese](https://en.wikipedia.org/wiki/Manganese).[[22]](https://en.wikipedia.org/wiki/Ecosystem#cite_note-Chapin215-23) Phosphorus enters ecosystems through [weathering](https://en.wikipedia.org/wiki/Weathering). As ecosystems age this supply diminishes, making phosphorus-limitation more common in older landscapes (especially in the tropics).[[22]](https://en.wikipedia.org/wiki/Ecosystem#cite_note-Chapin215-23) Calcium and sulfur are also produced by weathering, but acid deposition is an important source of sulfur in many ecosystems. Although magnesium and manganese are produced by weathering, exchanges between soil organic matter and living cells account for a significant portion of ecosystem fluxes. Potassium is primarily cycled between living cells and soil organic matter.[[22]](https://en.wikipedia.org/wiki/Ecosystem#cite_note-Chapin215-23)

Carbon cycle

Carbon is an essential part of all organic molecules, and , carbon compounds such as carbon dioxide CO2 and methane CH4 as constituents of the atmosphere . Carbon moves between organisms and the atmosphere as a consequence of two biological processes: photosynthesis and respiration. Photosynthesis removes CO2 from the atmosphere whereas respiration by primary producers and consumers including decomposers returns carbon to the atmosphere in the form of CO2 .In aquatic ecosystems CO2 must dissolve in water CO2 enters a chemical equilibrium with bicarbonate HCO3- and carbonate CO3-. Carbon in soils peat fossil fuels and carbonate rock would generally take a long time to return to the atmosphere .During modern times , however , fossil fuels have become a major source of atmospheric CO2 as humans have tapped in to fossil fuel supplies to provide energy for their economic systems.(industrial revolution).

THE NITROGEN CYCLE

**Nitrogen cycle**, circulation of [nitrogen](https://www.britannica.com/science/nitrogen) in various forms through nature. Nitrogen, a component of [proteins](https://www.britannica.com/science/protein) and [nucleic acids](https://www.britannica.com/science/nucleic-acid), is essential to [life](https://www.britannica.com/science/life) on [Earth](https://www.britannica.com/place/Earth). Although 78 percent by volume of the [atmosphere](https://www.britannica.com/science/atmosphere) is nitrogen [gas](https://www.britannica.com/science/gas-state-of-matter), this abundant reservoir exists in a form unusable by most organisms. Through a series of microbial transformations, however, nitrogen is made available to [plants](https://www.britannica.com/plant/plant), which in turn ultimately sustain all [animal](https://www.britannica.com/animal/animal) life. The steps, which are not altogether sequential, fall into the following classifications: [nitrogen fixation](https://www.britannica.com/science/nitrogen-fixation), nitrogen assimilation, ammonification, nitrification, and [denitrification](https://www.britannica.com/science/denitrification).

Nitrogen fixation, in which nitrogen gas is converted into inorganic nitrogen [compounds](https://www.britannica.com/science/chemical-compound), is mostly (90 percent) accomplished by certain [bacteria](https://www.britannica.com/science/bacteria) and [blue-green algae](https://www.britannica.com/science/blue-green-algae). A much smaller amount of free nitrogen is fixed by abiotic means (e.g., [lightning](https://www.britannica.com/science/lightning-meteorology), [ultraviolet radiation](https://www.britannica.com/science/ultraviolet-radiation), electrical equipment) and by conversion to [ammonia](https://www.britannica.com/science/ammonia) through the FERTILIZERS. Nitrates and ammonia resulting from [nitrogen](https://www.britannica.com/science/nitrogen-assimilation) fixation are [assimilated](https://www.merriam-webster.com/dictionary/assimilated) into the specific [tissue](https://www.britannica.com/science/tissue) [compounds](https://www.merriam-webster.com/dictionary/compounds) of algae and higher plants. Animals then ingest these algae and plants, converting them into their own body compounds.

The remains of all living things—and their waste products—are decomposed by microorganisms in the process of [ammonification](https://www.britannica.com/science/ammonification), which yields ammonia (NH3) and ammonium (NH4+). (Under anaerobic, or oxygen-free, conditions, foul-smelling putrefactive products may appear, but they too are converted to ammonia in time.) Ammonia can leave the [soil](https://www.britannica.com/science/soil) or be converted into other nitrogen compounds, depending in part on soil conditions.

[Nitrification](https://www.britannica.com/science/nitrification), a process carried out by [nitrifying bacteria](https://www.britannica.com/science/nitrifying-bacterium), transforms soil ammonia into [nitrates](https://www.britannica.com/science/nitrate) (NO3−), which plants can incorporate into their own tissues.

[Nitrates](https://www.britannica.com/science/nitrate) also are metabolized by [denitrifying bacteria](https://www.britannica.com/science/denitrifying-bacteria), which are especially active in water-logged anaerobic soils. The action of these bacteria tends to deplete soil nitrates, forming free atmospheric nitrogen.

