



The nitrogen cycle

Nitrogen is cycled through air, water and soil, undergoing many transformations made possible by the actions of specialized bacteria.

The term “organic nitrogen” is used to describe a nitrogen compound that had its origin in living material. Nitrogen is found in protein and urea which is a byproduct of protein digestion. When a plant or animal dies or an animal excretes waste, organic nitrogen is released.

Bacteria use various forms of nitrogen to survive and in the process convert organic nitrogen into ammonia (NH₃) or ammonium (NH₄⁺), a process called *ammonification*.

The addition of oxygen allows different bacteria to convert ammonium to nitrite (NO₂⁻), and still other bacteria to change the nitrite to nitrate (NO₃⁻) during *nitrification*. The need for oxygen defines nitrification as an aerobic process.

Denitrification happens when other bacteria take the nitrites and nitrates

and change them into nitrogen gas (N₂). Denitrification is an anaerobic process, taking place when no oxygen or extremely low concentrations of oxygen are available. Denitrification also requires a source of carbon.

Nitrogen gas is very plentiful and makes up about 80 percent of the earth’s atmosphere (oxygen accounts for slightly less than 20 percent).

Anammox bacteria are unique in their ability to convert ammonium and nitrite directly to nitrogen gas without the need for oxygen or a carbon source.

Atmospheric nitrogen gas becomes a source of nitrogen for plants, but it must first be processed into a usable form, a function again performed mostly by bacteria. The bacteria combine nitrogen with hydrogen to produce ammonia which they then convert further using enzymes to make their own organic compounds. An example is the *Rhizobium* bacteria that lives in legume plant root nodules. Plants can also absorb nitrate or ammonium ions from the soil via their root hairs.