2. Nitrogen Cycle:

The nitrogen cycle is the set of biogeochemical processes by which nitrogen undergoes chemical reactions, changes form, and moves through difference reservoirs on earth, including living organisms.

Nitrogen is required for all organisms to live and grow because it is the essential component of DNA, RNA, and protein. However, most organisms cannot use atmospheric nitrogen, the largest reservoir. The five processes in the nitrogen cycle

i. Nitrogen fixation

ii. Nitrogen uptake

iii. Nitrogen mineralization

iv. Nitrification

v. De-nitrification

Humans influence the global nitrogen cycle primarily through the use of nitrogen-based fertilizers.

I. Nitrogen fixation: N_2 -> NH_4^+

Nitrogen fixation is the process wherein N_2 is converted to ammonium, essential because it is the only way that organisms can attain nitrogen directly from the atmosphere. Certain bacteria, for example those among the genus Rhizobium, are the only organisms that fix nitrogen through metabolic processes.

Nitrogen fixing bacteria often form symbiotic relationships with host plants. This symbiosis is well-known to occur in the legume family of plants (e.g. beans, peas, and clover). In this relationship, nitrogen fixing bacteria inhabit legume root nodules and receive carbohydrates and a favourable environment from their host plant in exchange for some of the nitrogen they fix. There are also nitrogen fixing bacteria that exist without plant hosts, known as free-living nitrogen fixers. In aquatic environments, blue-green algae (really a bacteria called cyanobacteria) is an important free-living nitrogen fixer.

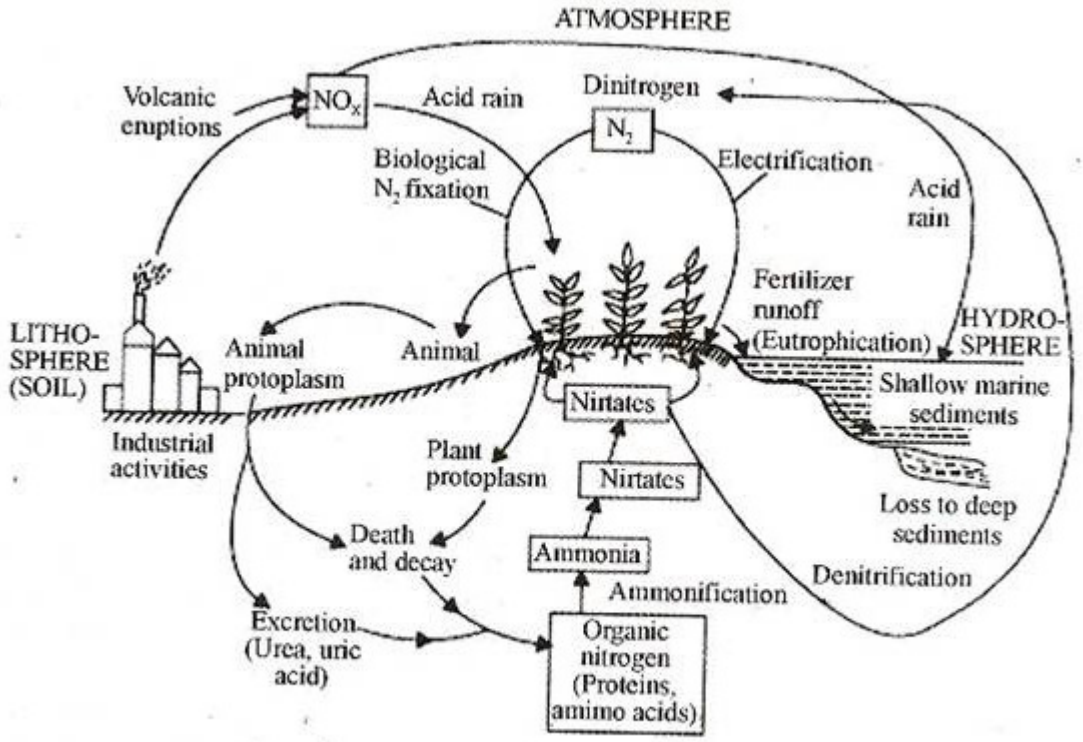
II. Nitrogen uptake: NH_4^+ -> Organic N

The ammonia produced by nitrogen fixing bacteria is usually quickly incorporated into protein and other organic nitrogen compounds, either by a host plant, the bacteria itself, or another soil organism.

III. Nitrogen mineralization: Organic N ->NH_4^+

After nitrogen is incorporated into organic matter, it is often converted back into inorganic nitrogen by a process called nitrogen mineralization, otherwise known as decay. When organisms die, decomposers (such as bacteria and fungi) consume the organic matter and lead to the process of decomposition.

During this process, a significant amount of the nitrogen contained within the dead organism is converted to ammonium. Once in the form of ammonium, nitrogen is available for use by plants or for further transformation into nitrate (NO_3^-) through the process called nitrification.



A Nitrogen Cycle

IV. Nitrification: NH_4^+ -> NO_3^-

Some of the ammonium produced by decomposition is converted to nitrate via a process called nitrification. The bacteria that carry out this reaction gain energy from it. Nitrification requires the presence of oxygen, so nitrification can happen only in oxygen-rich environments like circulating or flowing waters and the very surface layers of soils and sediments. The process of nitrification has some important consequences.

Ammonium ions are positively charged and therefore stick (are sorbed) to negatively charged clay particles and soil organic matter. The positive charge prevents ammonium nitrogen from being washed out of the soil (or leached) by rainfall.

In contrast, the negatively charged nitrate ion is not held by soil particles and so can be washed down the soil profile, leading to decreased soil fertility and nitrate enrichment of downstream surface and groundwater's.

V. De-nitrification: NO_3^- -> N_2+ N_2O

Through de-nitrification, oxidized forms of nitrogen such as nitrate and nitrite (NO_2) are converted to di-nitrogen (N_2) and, to a lesser extent, nitrous oxide gas. De-nitrification is an anaerobic process that is carried out by denitrifying bacteria, which convert nitrate to nitrogen in the following sequence:

NO_3^--> NO_2^- -> NO ->N_2O ->N_2

Nitric oxide and nitrous oxide are both environmentally important gases. Nitric oxide (NO) contributes to smog, and nitrous oxide (N_2O) is an important greenhouse gas, thereby contributing to global climate change.