

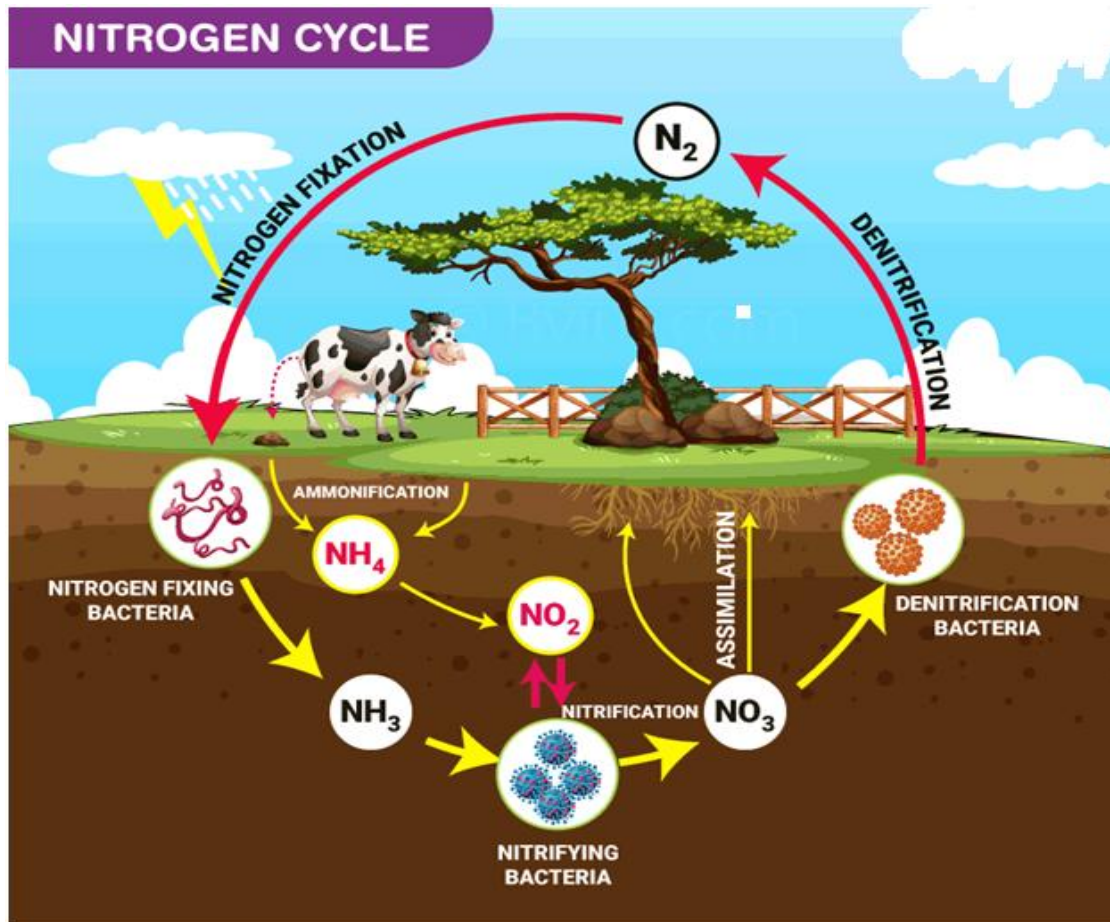


- ✚ Biology is a **branch of science that deals with living organisms and their vital processes.**
- ✚ Biology encompasses diverse fields, including botany, conservation, ecology, evolution, genetics, marine biology, medicine, microbiology, molecular biology, physiology, and zoology.
- ✚ There are four primary categories: **botany, human biology, microbiology and zoology.**
- ✚ Biology is **the study of life.** The word "biology" is derived from the Greek words "bios" (meaning life) and "logos" (meaning "study").
- ✚ In general, biologists study the structure, function, growth, origin, evolution and distribution of living organisms.
- ✚ **Aristotle** is regarded as the Father of Biology.



- ✚ He is also regarded as the Father of Zoology. He started classification with two kingdoms Animal and Plantae.
- ✚ Aristotle's theory of biology is known as "Aristotle's Biology" which describes metabolism, temperature regulation, and embryogenesis.
- ✚ Biology is a natural science that utilizes different structural and functional concepts for the differentiation of living beings from non-living beings.
- ✚ At present times, as a result of cross-disciplinary research, other disciplines like chemistry, physics, computer science, and medicine have been integrated with biology, resulting in areas like biochemistry, biophysics, biomedicine, and bioinformatics.
- ✚ Biology is further divided into separate branches for the convenience of study, even though all of these branches are interrelated to one another.
- ✚ Biology is separated into botany (the study of plants) and zoology (the study of animals), morphology (structure), and physiology (function).
- ✚ Traditionally, biology was only associated with the structure and function of living beings.
- ✚ With time, however, biology deals with the fundamental levels of life, resulting in a separate discipline termed, molecular biology.
Biology has now been developed into modern biology which is based on certain foundations like cell theory, evolution, genetics, homeostasis, and chemical energy.
- ✚ Biology defines cell as the fundamental unit of life, which is common in all living beings, microscopic, and macroscopic.

Nitrogen Cycle- Steps And Significance



Process of the Nitrogen Cycle consists of the following steps – Nitrogen fixation, Nitrification, Assimilation, Ammonification and Denitrification. These processes take place in several stages and are explained below:

Nitrogen Fixation Process

It is the initial step of the nitrogen cycle. Here, Atmospheric nitrogen (N_2) which is primarily available in an inert form, is converted into the usable form -ammonia (NH_3).

During the process of Nitrogen fixation, the inert form of nitrogen gas is deposited into soils from the atmosphere and surface waters, mainly through precipitation.

The entire process of Nitrogen fixation is completed by symbiotic bacteria, which are known as Diazotrophs. *Azotobacter* and *Rhizobium* also have a major role in this process. These bacteria consist of a nitrogenase enzyme, which has the capability to combine gaseous nitrogen with hydrogen to form ammonia.

Nitrogen fixation can occur either by atmospheric fixation- which involves lightening, or industrial fixation by manufacturing ammonia under high temperature and pressure conditions. This can also be fixed through man-made processes, primarily industrial processes that create ammonia and nitrogen-rich fertilisers.

Types of Nitrogen Fixation

1. **Atmospheric fixation:** A natural phenomenon where the energy of lightning breaks the nitrogen into nitrogen oxides, which are then used by plants.
2. **Industrial nitrogen fixation:** It is a man-made alternative that aids in nitrogen fixation by the use of ammonia. Ammonia is produced by the direct combination of nitrogen and hydrogen. Later, it is converted into various fertilisers such as urea.
3. **Biological nitrogen fixation:** We already know that nitrogen is not used directly from the air by plants and animals. Bacteria like *Rhizobium* and blue-green algae transform the unusable form of nitrogen into other compounds that are more readily usable. These nitrogen compounds get fixed in the soil by these microbes.

Nitrification

In this process, the ammonia is converted into nitrate by the presence of bacteria in the soil. Nitrites are formed by the oxidation of ammonia with the help of *Nitrosomonas* bacteria species. Later, the produced nitrites are converted into nitrates by *Nitrobacter*. This conversion is very important as ammonia gas is toxic for plants.

The reaction involved in the process of Nitrification is as follows:



Assimilation

Primary producers – plants take in the nitrogen compounds from the soil with the help of their roots, which are available in the form of ammonia, nitrite ions, nitrate ions or ammonium ions and are used in the formation of the plant and animal proteins. This way, it enters the food web when the primary consumers eat the plants.

Ammonification

When plants or animals die, the nitrogen present in the organic matter is released back into the soil. The decomposers, namely bacteria or fungi present in the soil, convert the organic matter back into ammonium. This process of decomposition produces ammonia, which is further used for other biological processes.

Denitrification

Denitrification is the process in which the nitrogen compounds make their way back into the atmosphere by converting nitrate (NO_3^-) into gaseous nitrogen (N). This process of the nitrogen cycle is the final stage and occurs in the absence of oxygen. Denitrification is carried out by the denitrifying bacterial species- *Clostridium* and *Pseudomonas*, which will process nitrate to gain oxygen and gives out free nitrogen gas as a byproduct.

Importance of Nitrogen Cycle

The importance of the nitrogen cycle are as follows:

1. Helps plants to synthesise chlorophyll from the nitrogen compounds.
2. Helps in converting inert nitrogen gas into a usable form for the plants through the biochemical process.
3. In the process of ammonification, the bacteria help in decomposing the animal and plant matter, which indirectly helps to clean up the environment.
4. Nitrates and nitrites are released into the soil, which helps in enriching the soil with the necessary nutrients required for cultivation.
5. Nitrogen is an integral component of the cell and it forms many crucial compounds and important biomolecules.

Nitrogen is also cycled by human activities such as the combustion of fuels and the use of nitrogen fertilisers. These processes increase the levels of nitrogen-containing compounds in the atmosphere. The fertilisers containing nitrogen are washed away in lakes, rivers and result in eutrophication.

Conclusion

- Nitrogen is abundant in the atmosphere, but it is unusable to plants or animals unless it is converted into nitrogen compounds.
- Nitrogen-fixing bacteria play a crucial role in fixing atmospheric nitrogen into nitrogen compounds that can be used by plants.
- The plants absorb the usable nitrogen compounds from the soil through their roots. Then, these nitrogen compounds are used for the production of proteins and other compounds in the plant cell.
- Animals assimilate nitrogen by consuming these plants or other animals that contain nitrogen. Humans consume proteins from these plants and animals. The nitrogen then assimilates into our body system.
- During the final stages of the nitrogen cycle, bacteria and fungi help decompose organic matter, where the nitrogenous compounds get dissolved into the soil which is again used by the plants.
- Some bacteria then convert these nitrogenous compounds in the soil and turn it into nitrogen gas. Eventually, it goes back to the atmosphere.
- These sets of processes repeat continuously and thus maintain the percentage of nitrogen in the atmosphere.

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