

Difference Between Nitrification and Denitrification

www.differencebetween.com

Key Difference - Nitrification vs Denitrification

The [nitrogen cycle](#) is an important biogeochemical cycle in which nitrogen is converted into different chemical forms such as NH_3 , NH_4^+ , NO_2^- , NO_3^- etc. There are four major processes in the nitrogen cycle. They are fixation, ammonification, nitrification, and denitrification. Many of these processes are carried out by microorganisms, especially [bacteria](#) present in the soil. Nitrification and denitrification are the two main stages which transform atmospheric [nitrogen](#) into [nitrate](#) and nitrate back into atmospheric nitrogen. **Nitrification is the biological transformation of ammonium (NH_4^+) into nitrate (NO_3^-) by oxidation while denitrification is the biological transformation of nitrate to nitrogenous gases (N_2) by reduction.** This is the key difference between nitrification and denitrification.

What is Nitrification?

Nitrification is the process that converts [ammonia or ammonium](#) ions into nitrates by oxidation. It is an integral part of the nitrogen cycle. It is facilitated by two types of chemoautotrophic [aerobic bacteria](#) such as *Nitrosomonas* and *Nitrobacter*. They work under aerobic conditions. Nitrification is initiated by *Nitrosomonas*. *Nitrosomonas* bacteria convert ammonia and ammonium ions into nitrite. Secondly, [nitrite](#) is converted to nitrate by *Nitrobacter*. These two steps can be represented as follows.



Nitrification is of utmost importance for the continuance of the ecosystem and organic matter decomposition. Nitrification is also an essential process for plants. Plants obtain nitrogen as nitrates. Nitrate is the prime accessible form of nitrogen in plants. Hence, nitrification is extremely important for agriculture and plants.

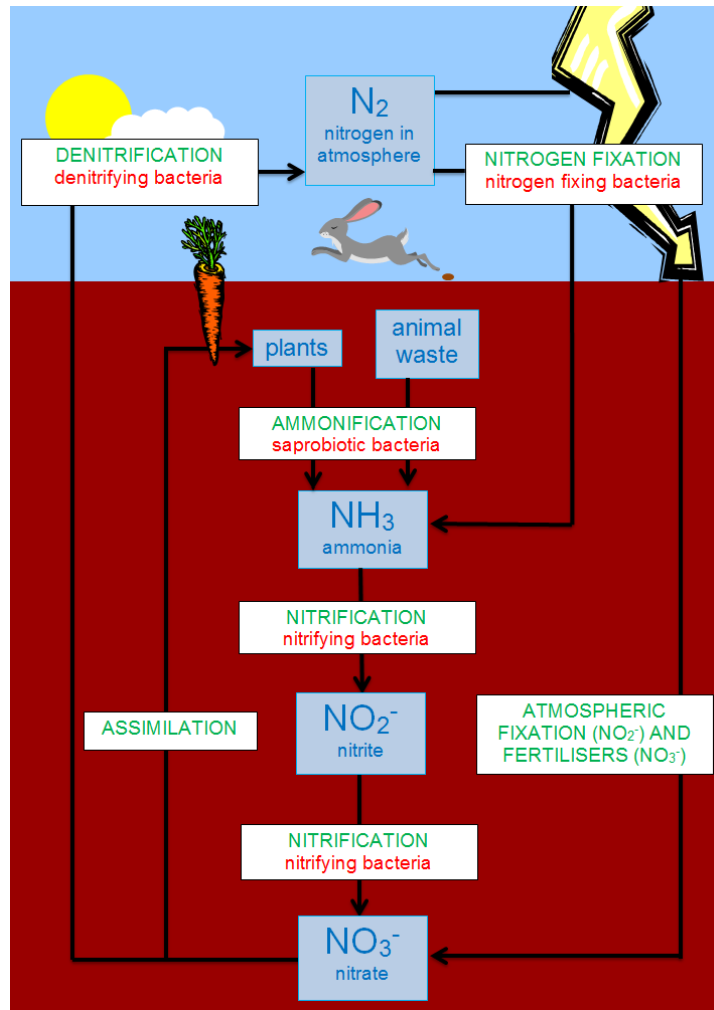


Figure 01: Nitrogen cycle

What is Denitrification?

Denitrification is the process of reducing nitrates in the soil into atmospheric nitrogen gas by denitrifying bacteria. This is opposite of nitrification, which is described in the above section. Denitrification is an essential step in the nitrogen cycle, which releases fixed nitrogen gas back into the atmosphere. Denitrification is facilitated by denitrifying bacteria such as *Pseudomonas*, and *Clostridium*. These bacteria are facultative anaerobic and heterotrophic bacteria. They work under anaerobic or anoxic conditions like waterlogged soils. They use nitrate as their respiratory substrate, and as a result of it, nitrate is released as a gaseous nitrogen to the atmosphere.

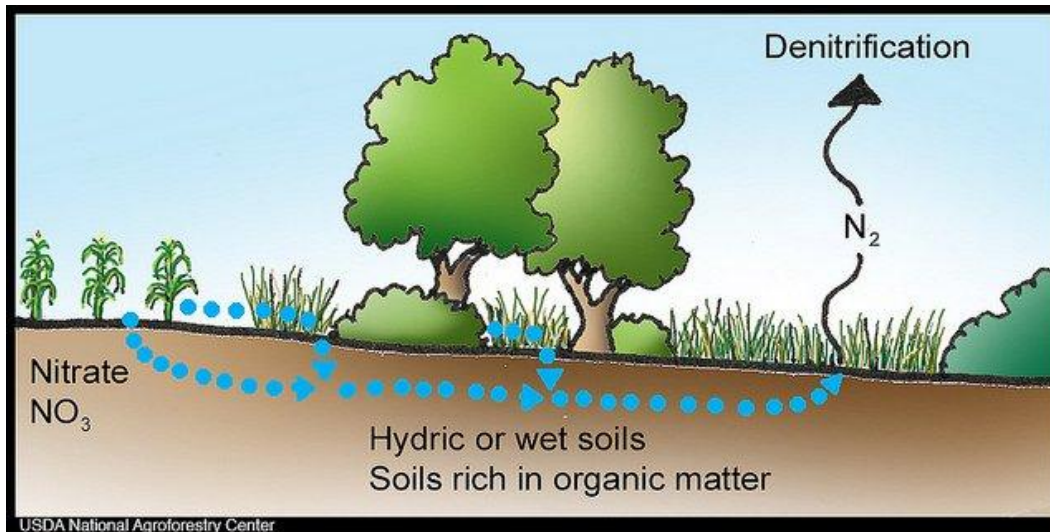


Figure 02: Denitrification

What are the similarities between Nitrification and Denitrification?

- Nitrification and denitrification are two major processes of the nitrogen cycle.
- Both processes are driven by bacteria.

What is the difference between Nitrification and Denitrification?

Nitrification vs Denitrification	
Nitrification is the oxidation of ammonia or ammonium ions into nitrate ions by nitrifying bacteria.	Denitrification is the reduction of nitrate into gaseous nitrogen by denitrifying bacteria.
Reaction Sequences	
Nitrification occurs as $\text{NH}_3 \rightarrow \text{NH}_4^+ \rightarrow \text{NO}_2^- \rightarrow \text{NO}_3^-$	Denitrification occurs as $\text{NO}_3^- \rightarrow \text{NO}_2^- \rightarrow \text{NO} \rightarrow \text{N}_2\text{O} \rightarrow \text{N}_2$
In Agriculture	
Nitrification is an important process for agriculture since it produces a plant-accessible form of nitrogen (nitrate ions)	Denitrification is detrimental to crop production since plant accessible nitrogen source (nitrate) is converted to gaseous

	nitrogen (N ₂).
Reactions	
Nitrification occurs by oxidation.	Denitrification occurs by reduction
Bacteria Involved	
Nitrification is facilitated by chemoautotrophic aerobic bacteria.	Denitrification is facilitated by facultative bacteria or heterotrophic denitrifying bacteria.
Benefits	
Nitrification is beneficial for agriculture since it provides nitrate for plants.	Denitrification is beneficial for aquatic habitats and industrial or sewage wastewater treatment.
Sensitivity to Environmental Stresses	
Nitrifiers are more sensitive to environmental stresses.	Denitrifiers are less sensitive to environmental stresses.
pH Range	
Nitrification occurs in pH between 6.5 and 8.5.	Denitrification occurs in pH between 7.0 and 8.5.
Temperature	
Nitrification temperature ranges between 16 and 35 °C	Denitrification temperature ranges between 26 and 38 °C
Conditions	
Nitrification favors aerobic conditions.	Denitrification favors anoxic conditions.
Inhibition	
Nitrification occurs through flooding, high salinity, high acidity, high alkalinity, excessive tilling and toxic compounds.	Denitrification is inhibited by reduced nitrification, lower nitrate levels, fertilizer, and soil drainage.

Summary - Nitrification vs Denitrification

Nitrogen gas accounts for about 78% of the atmosphere by volume. Atmospheric nitrogen enters into the living world by a process called biological nitrogen fixation. It is done by nitrogen fixing bacteria. Nitrogen-fixing bacteria convert nitrogen into ammonia. Then this ammonia circulates via nitrogen cycle, supplying nitrogen to all living organisms. Ammonia and ammonium ions are converted into

nitrate by oxidation. This process is known as nitrification. Nitrification is a major stage in the nitrogen cycle. It is performed by aerobic bacteria such as Nitrosomonas and Nitrobacter. Soil nitrate is consumed by plants and other organisms. Nitrate in the soil is used as an energy source by denitrifying bacteria under anaerobic conditions. During that process, nitrate is converted back into atmospheric N₂ by reduction. This process is known as denitrification. This is the difference between nitrification and denitrification.

References:

1. "Nitrogen cycle." Wikipedia. Wikimedia Foundation, 16 June 2017. Web. [Available here](#). 24 June 2017.
2. "The nitrogen cycle." Khan Academy. N.p., n.d. Web. [Available here](#). 24 June 2017.

Image Courtesy:

1. "The Nitrogen Cycle" By Roseramona - ([CC BY-SA 3.0](#)) via [Commons Wikimedia](#)
2. "1.12 Buffers for nitrogen" by National Agroforestry Center ([CC BY 2.0](#)) via [Flickr](#)

How to Cite this Article?

APA: Difference Between Nitrification and Denitrification. (2017, June 27). Retrieved (date), from <http://www.differencebetween.com/difference-between-nitrification-and-vs-denitrification/>

MLA: "Difference Between Nitrification and Denitrification." *Difference Between.Com*. 27 June 2017. Web.

Chicago: "Difference Between Nitrification and Denitrification." *Difference Between.Com*. <http://www.differencebetween.com/difference-between-nitrification-and-vs-denitrification/> accessed [date]).



Copyright © 2010-2017 Difference Between. All rights reserved.