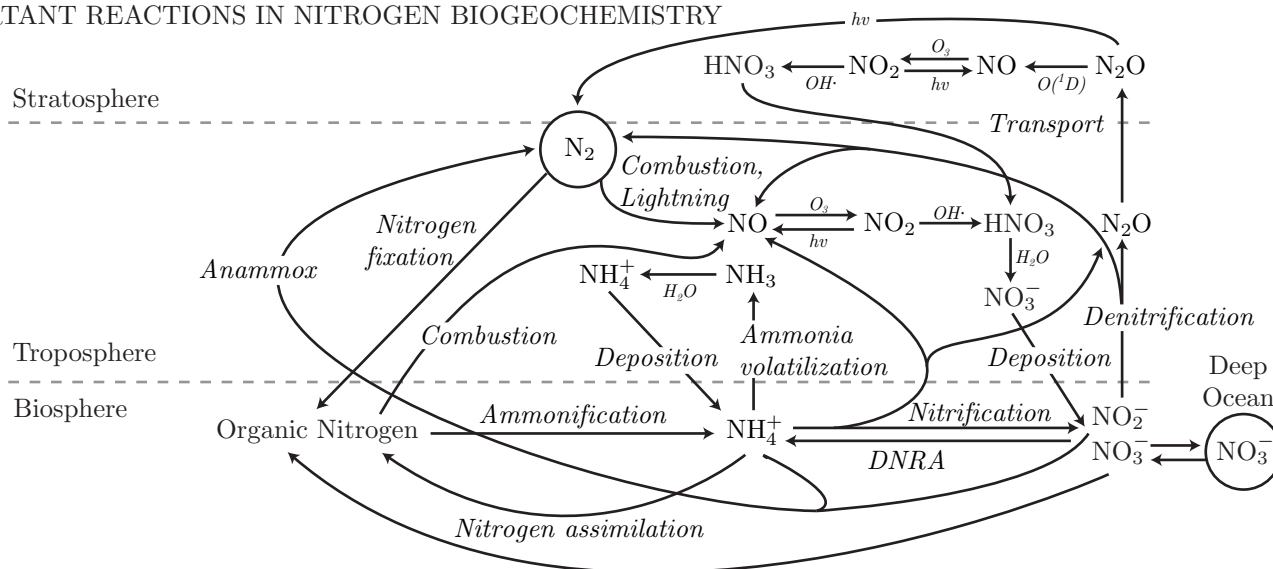


IMPORTANT REACTIONS IN NITROGEN BIOGEOCHEMISTRY



Small inorganic nitrogen compounds. Oxidation numbers are shown in parentheses.



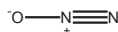
ammonia (-3)



ammonium (-3)



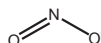
dinitrogen gas (0)



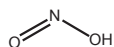
nitrous oxide (+1)



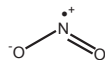
nitric oxide (+2)



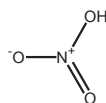
nitrite (+3)



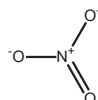
nitrous acid (+3)



nitrogen dioxide (+4)

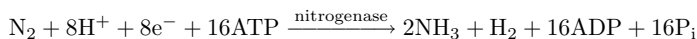


nitric acid (+5)

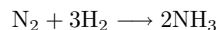


nitrate (+5)

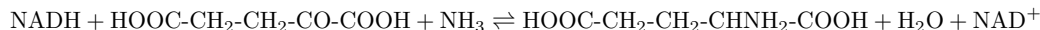
Nitrogen fixation. Conversion of atmospheric dinitrogen gas to ammonia. Performed in anaerobic conditions by several kinds of bacteria and blue-green algae that have the enzyme nitrogenase. Nitrogen-fixing organisms such as *Rhizobium* and *Frankia* are often found in the root nodules of legumes (Fabaceae).



Homo sapiens also performs this conversion using high temperature, high pressure, and a catalyst made mostly from iron (the Haber-Bosch process).

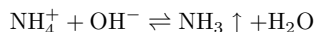


Nitrogen assimilation. Incorporation of inorganic nitrogen into amino acids, often via the GS-GOGAT pathway. Example: the production of the amino acid glutamate from the organic compound 2-oxoglutarate via the enzyme glutamate dehydrogenase:

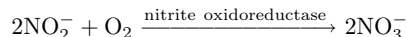
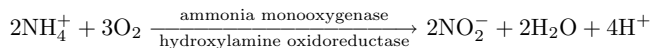


Ammonification. Mineralization of N by microbial decomposition. Reverse of assimilation.

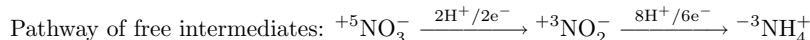
Ammonia volatilization. Ammonium ions equilibrate with ammonia gas that enters the atmosphere.



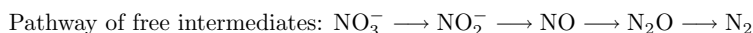
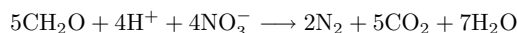
Nitrification. Conversion of ammonium to nitrate. The energy released by this reaction is used for carbon fixation in chemoautotrophic bacteria such as *Nitrosomonas* and *Nitrobacter*.



Dissimilatory nitrate reduction to ammonium (DNRA). Conversion of nitrate to ammonium under anaerobic conditions. Nitrogen oxides are used as terminal electron acceptor in oxidative phosphorylation. The second step is catalyzed by cytochrome *c* oxidase.



Denitrification. Dissimilatory reduction of nitrate to dinitrogen gas. Facultatively anaerobic bacteria such as *Pseudomonas* use nitrogen oxides as terminal electron acceptors in oxidative phosphorylation. Denitrification is catalyzed by reductases named for the compounds they reduce – e.g., nitric oxide reductase.



Anammox. Conversion of equal parts of ammonium and nitrite to dinitrogen gas by anaerobic bacteria such as *Kuenenia stuttgartiensis* and *Brocadia anammoxidans*.

