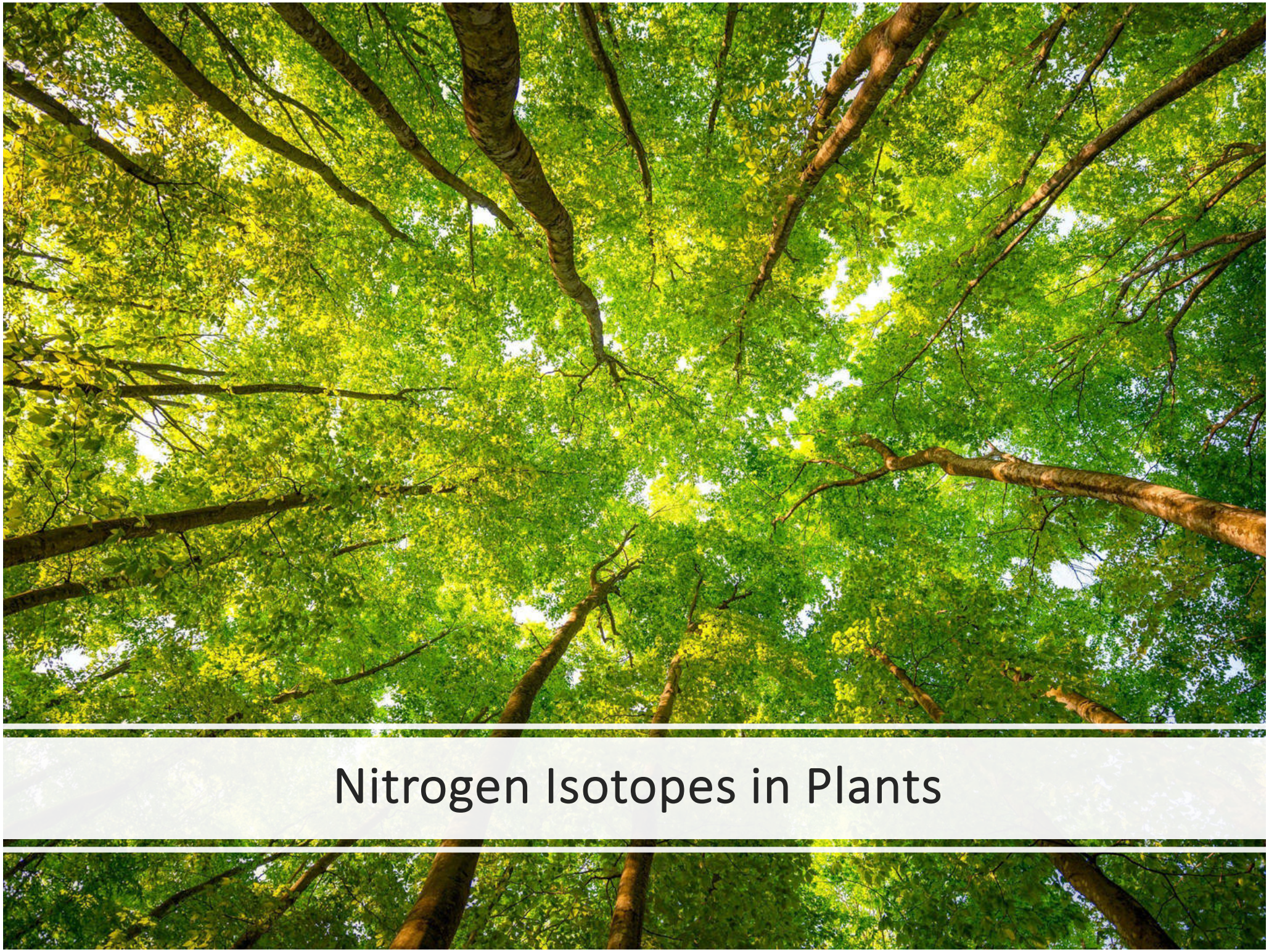
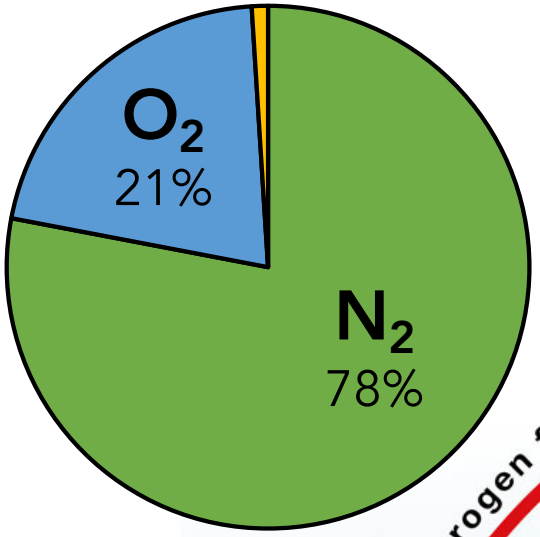


Nitrogen Isotopes in Plants

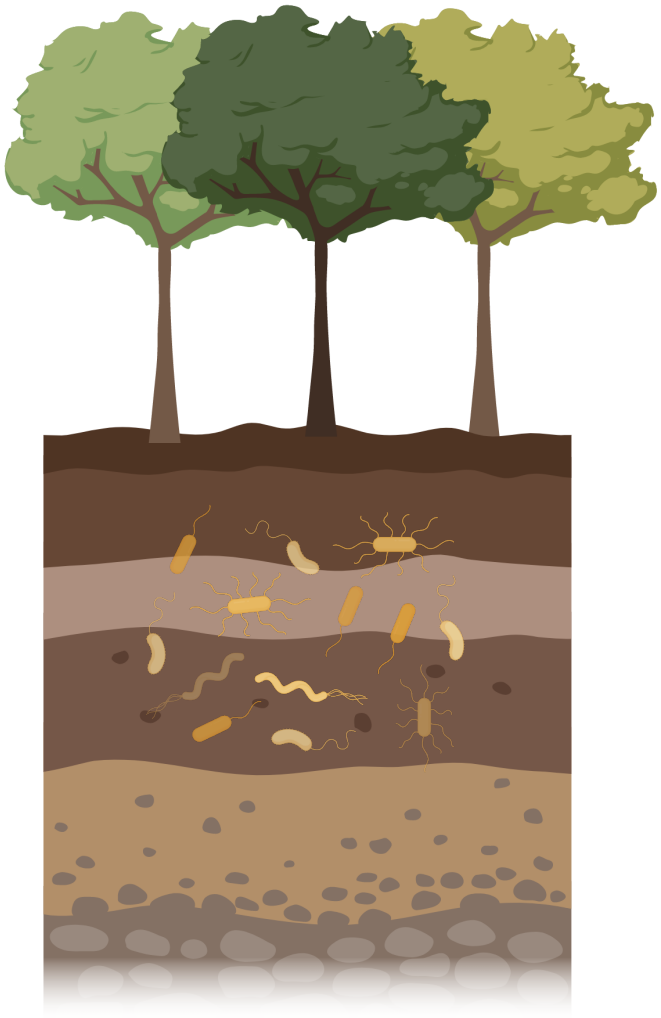


^{14}N ~99.6% abundance
^{15}N ~0.4% abundance

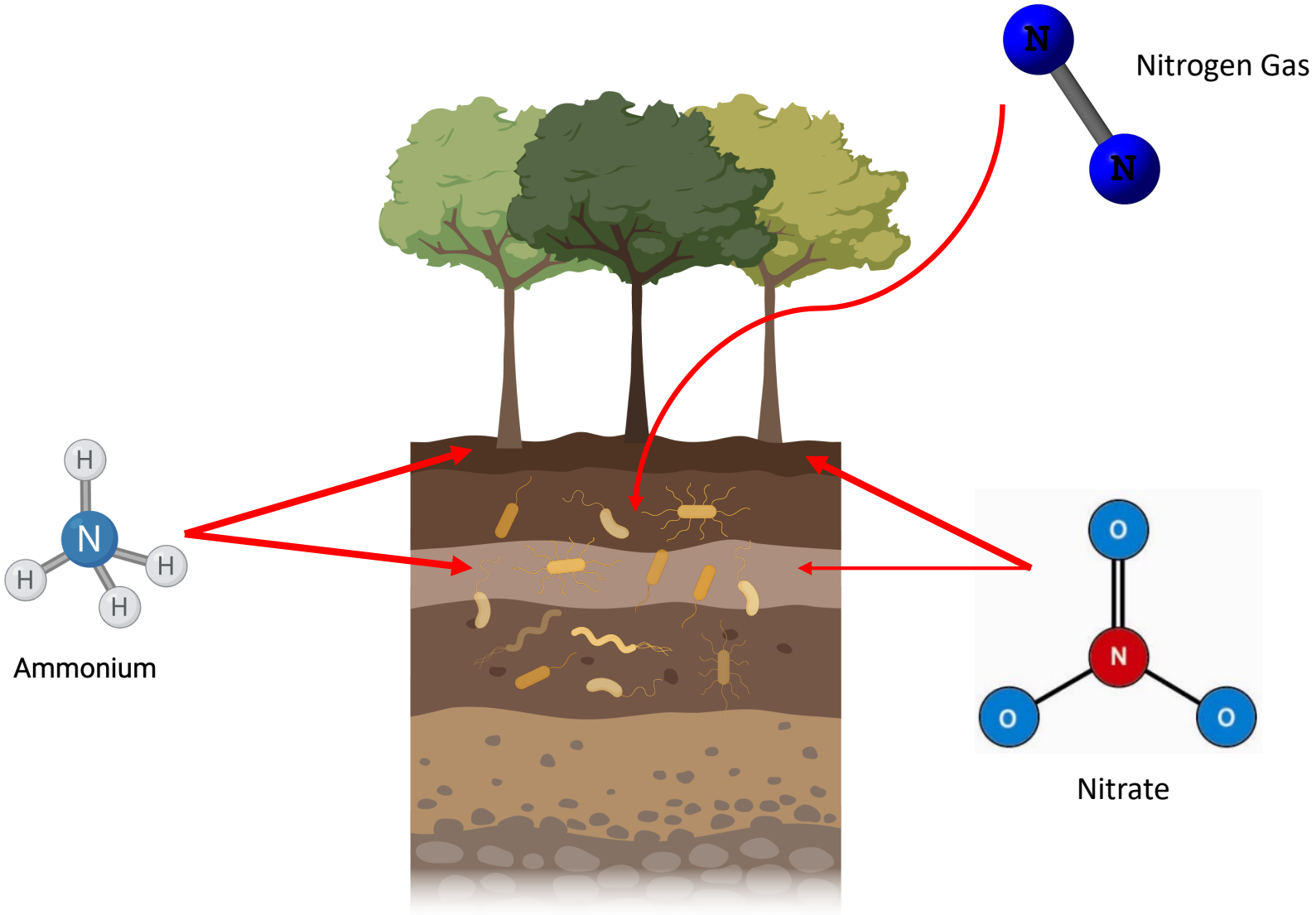
Nitrogen Cycle

N_2 in the atmosphere
Nitrogen fixation
Denitrification
lightning
Nitrogen fixation
Absorption of N_2 in animals
Nitrogen-fixing bacteria
Decomposers
Ammonification
Denitrifying bacteria
Assimilation
Absorption of N_2 in plants
NH_4^+
NO_3^-
NH_3
Nitrifying bacteria
Nitrifying bacteria
NO_2^-
Nitrification
Nitrification

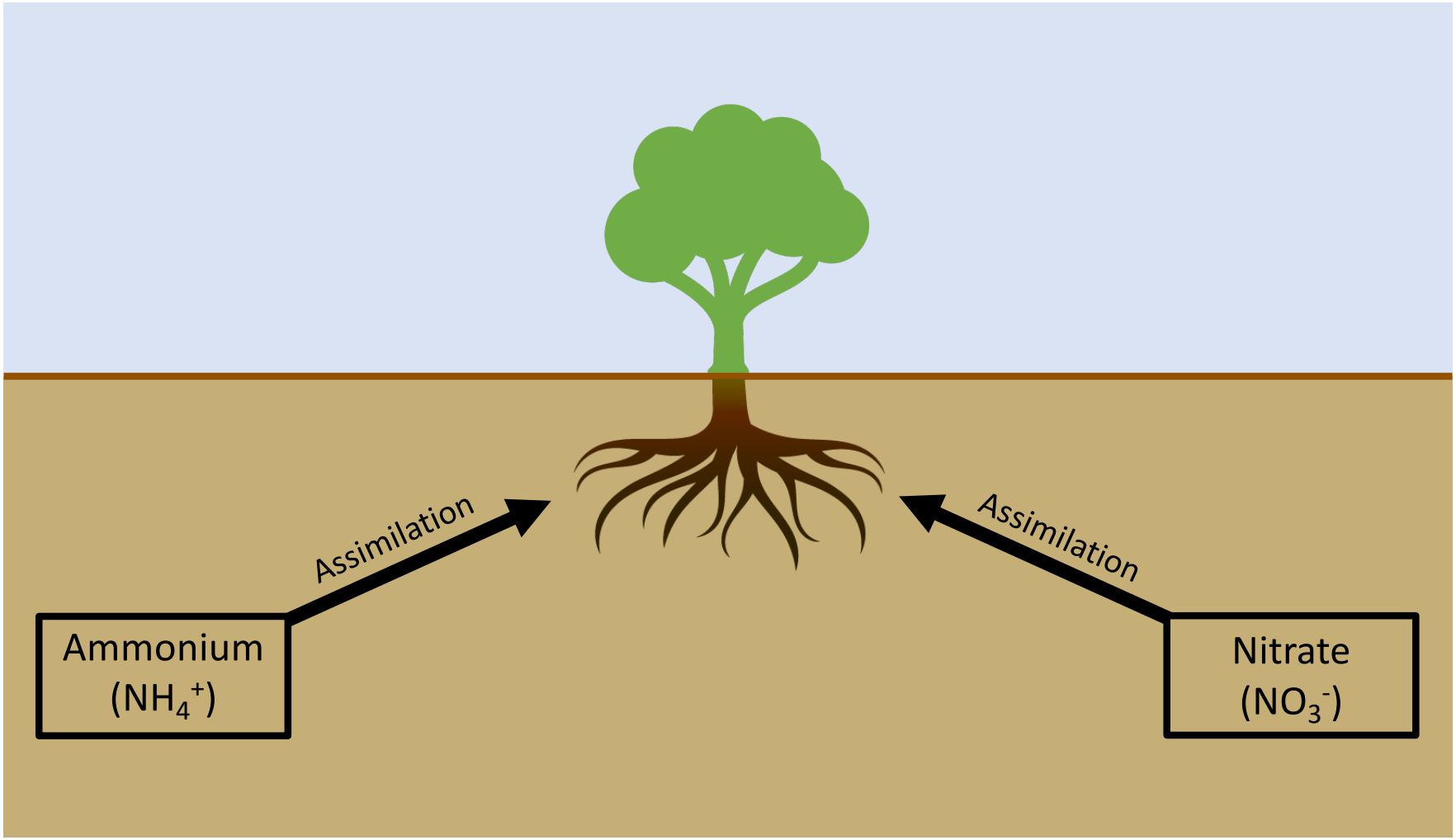
Nitrogen: The Basics



Nitrogen: The Basics

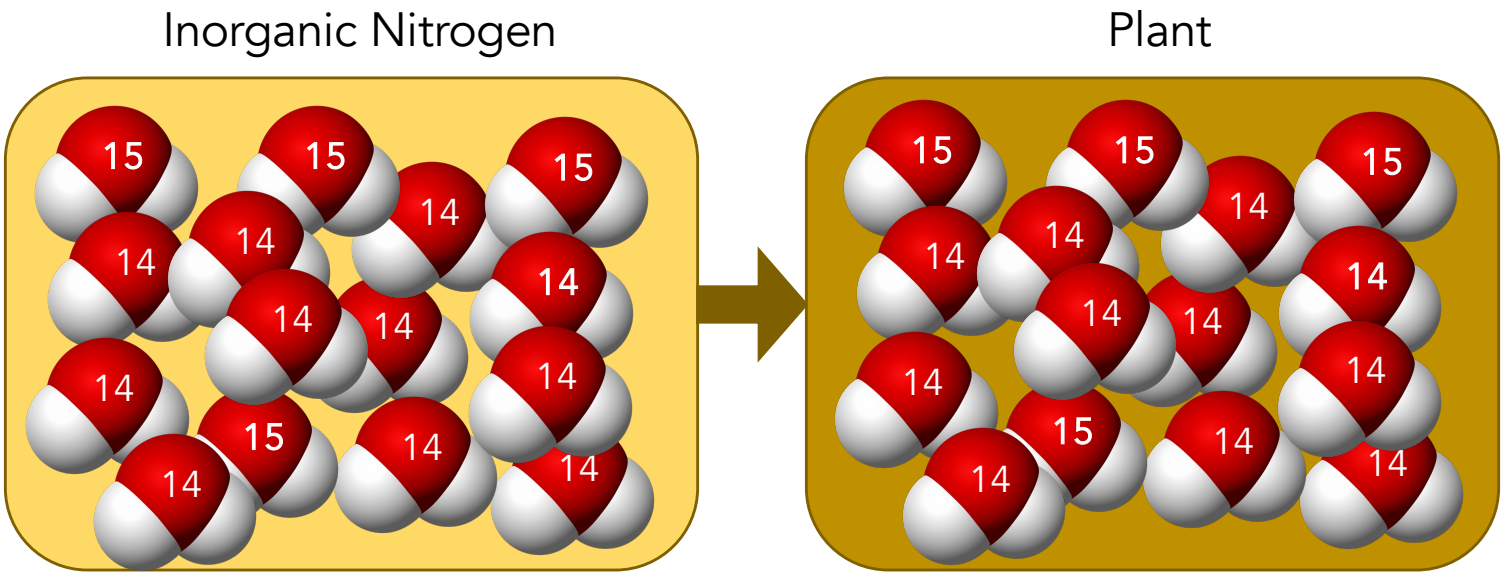


Nitrogen Assimilation

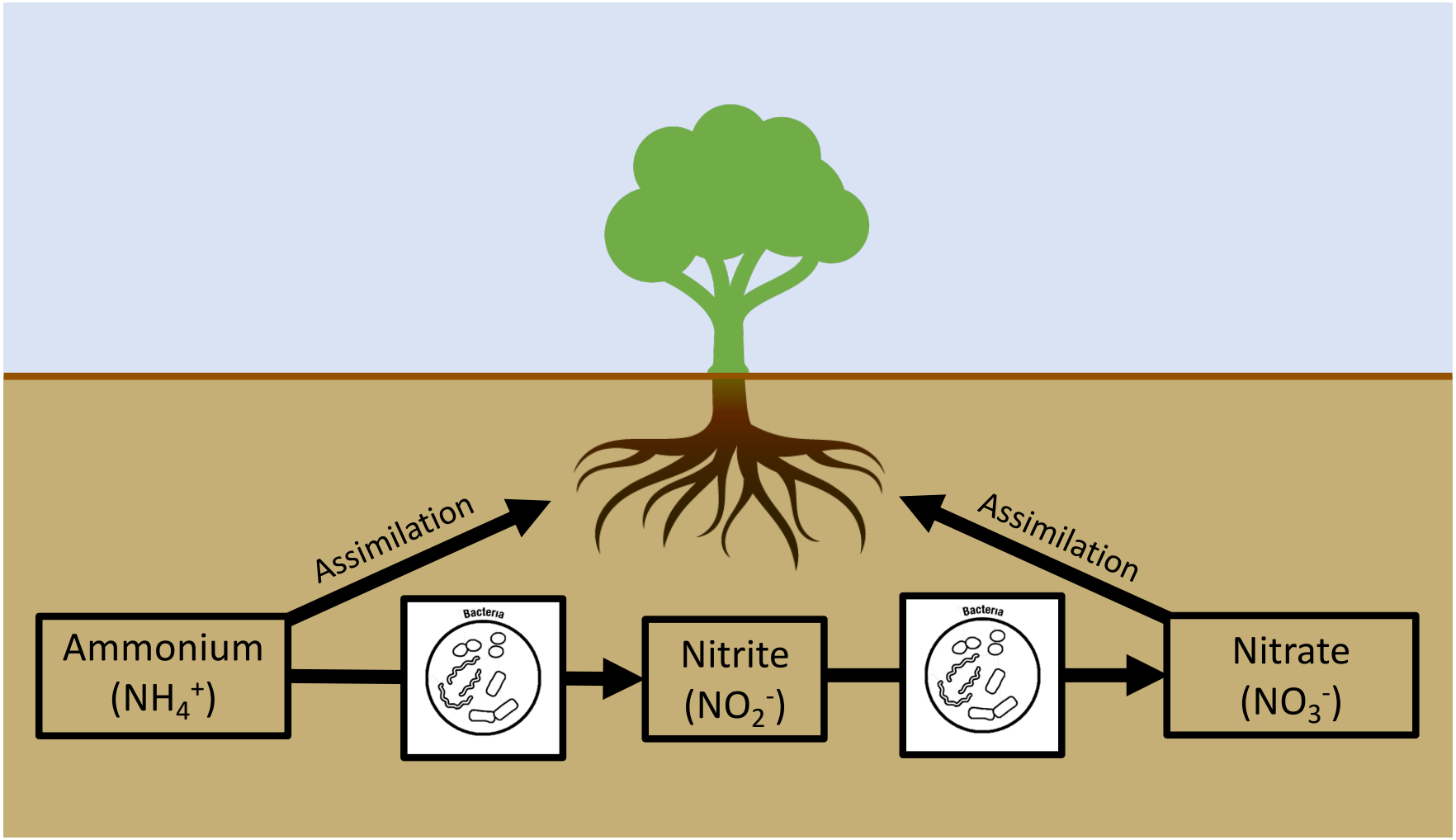


Nitrogen Assimilation

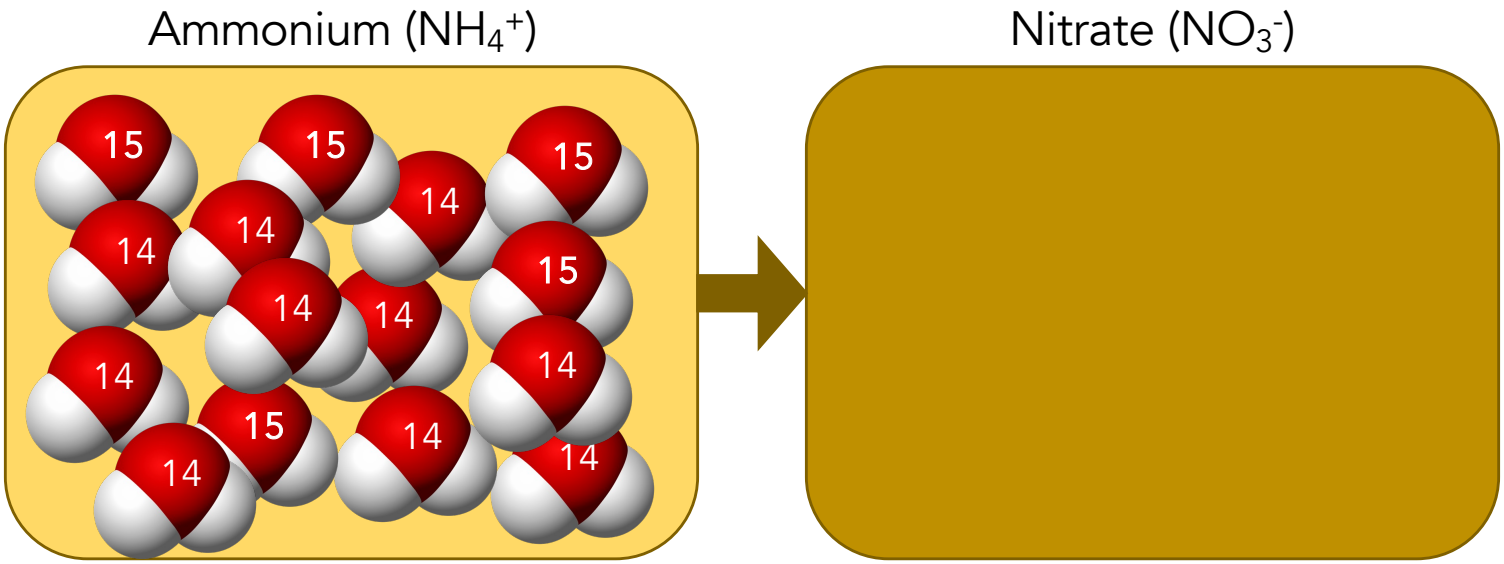
Since nitrogen is a limiting nutrient, plants can't be picky…



Nitrification



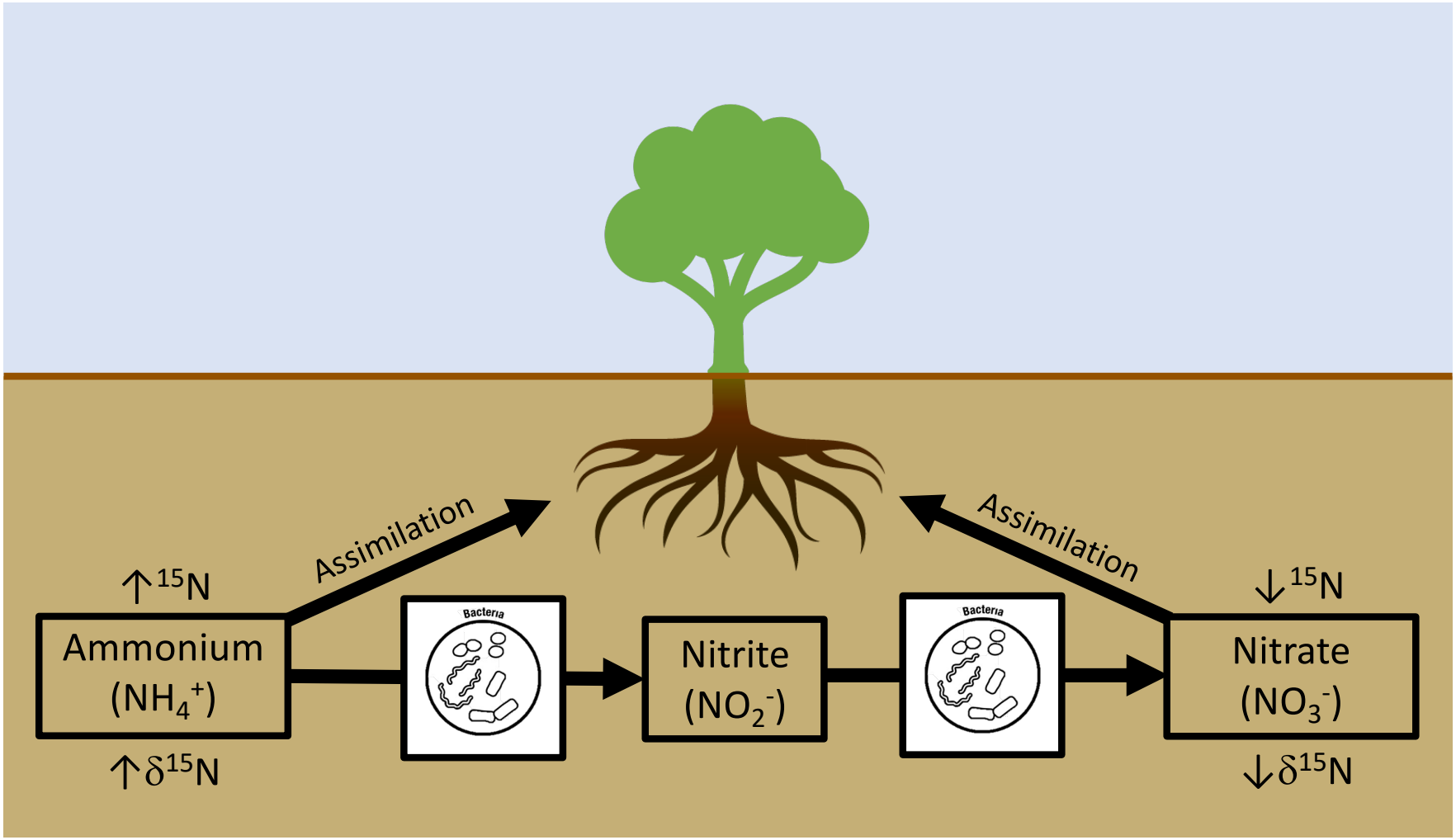
Nitrification: Lighter Goes Faster



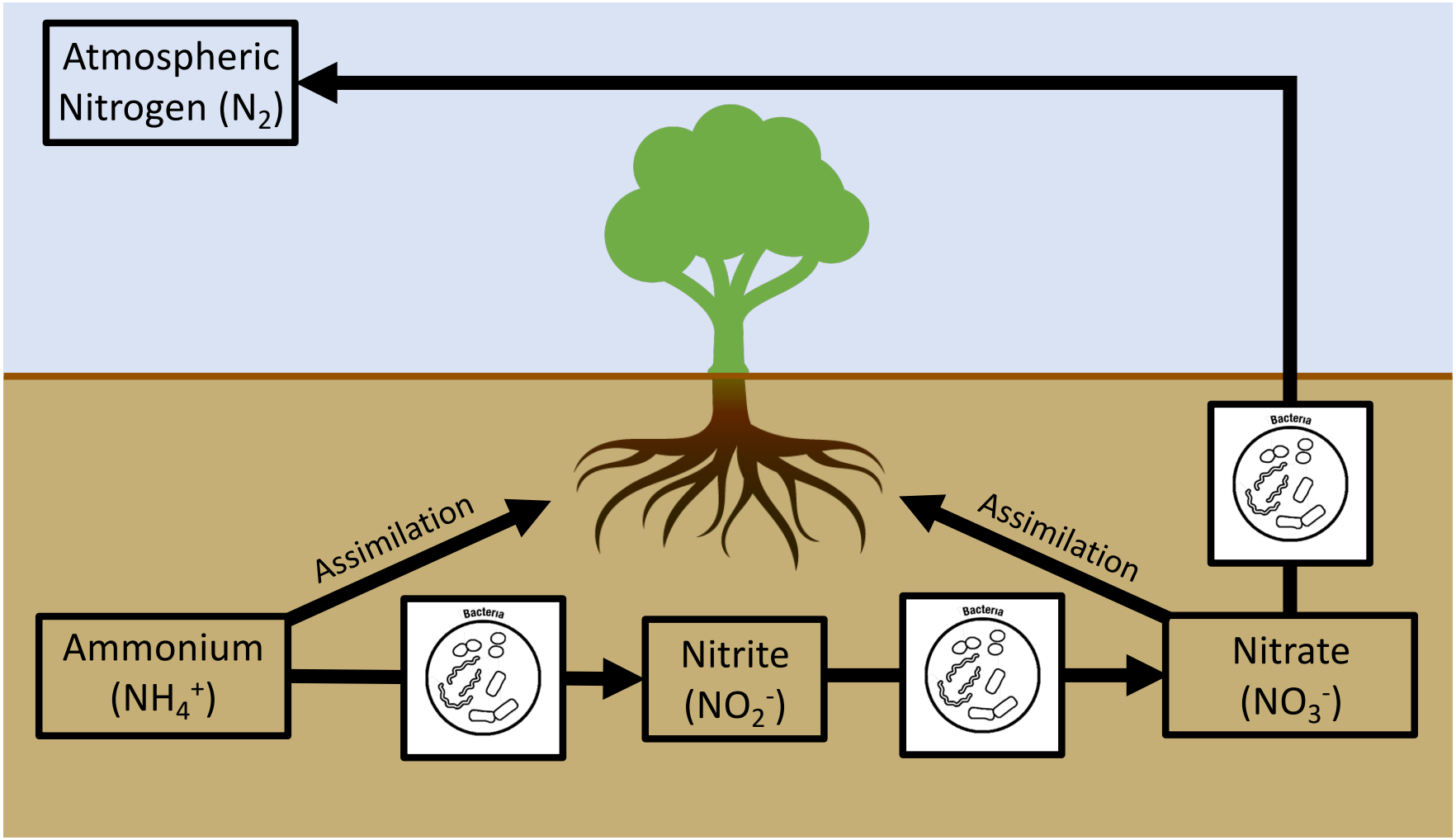
The **reactant (ammonium)** contains more ^{15}N than the **product (nitrate)**

The **reactant (ammonium)** has a higher $\delta^{15}N$ value than the **product (nitrate)**

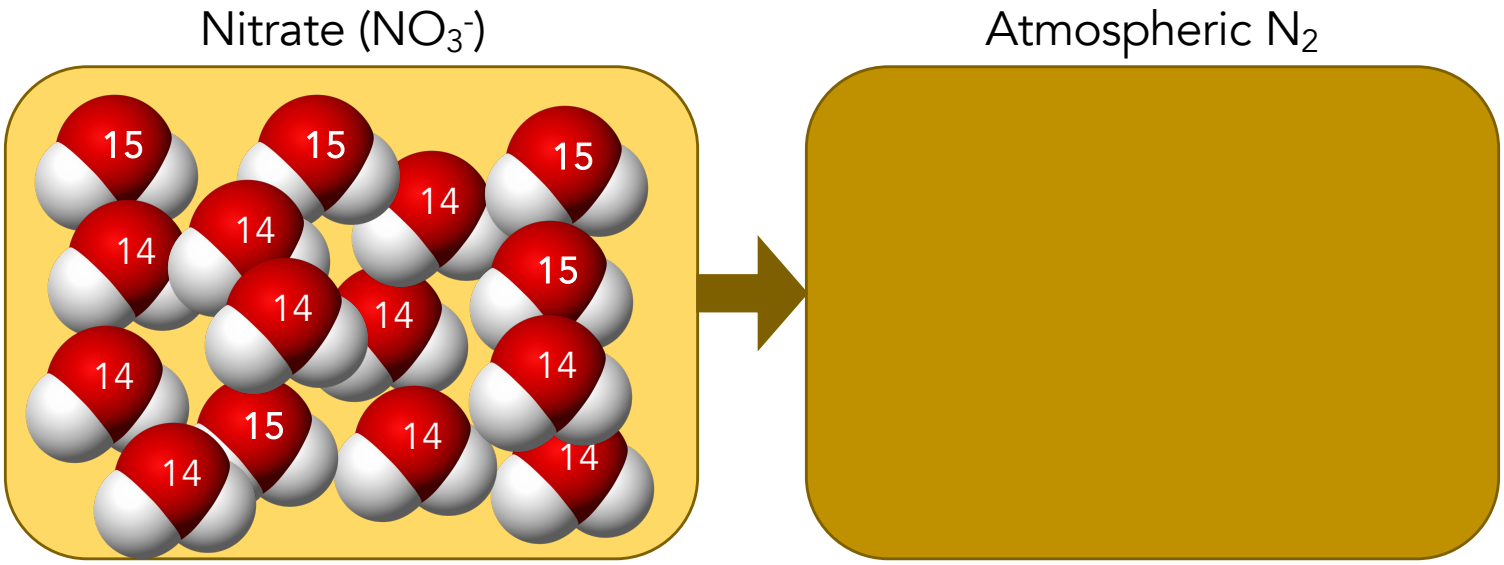
Nitrification



Denitrification



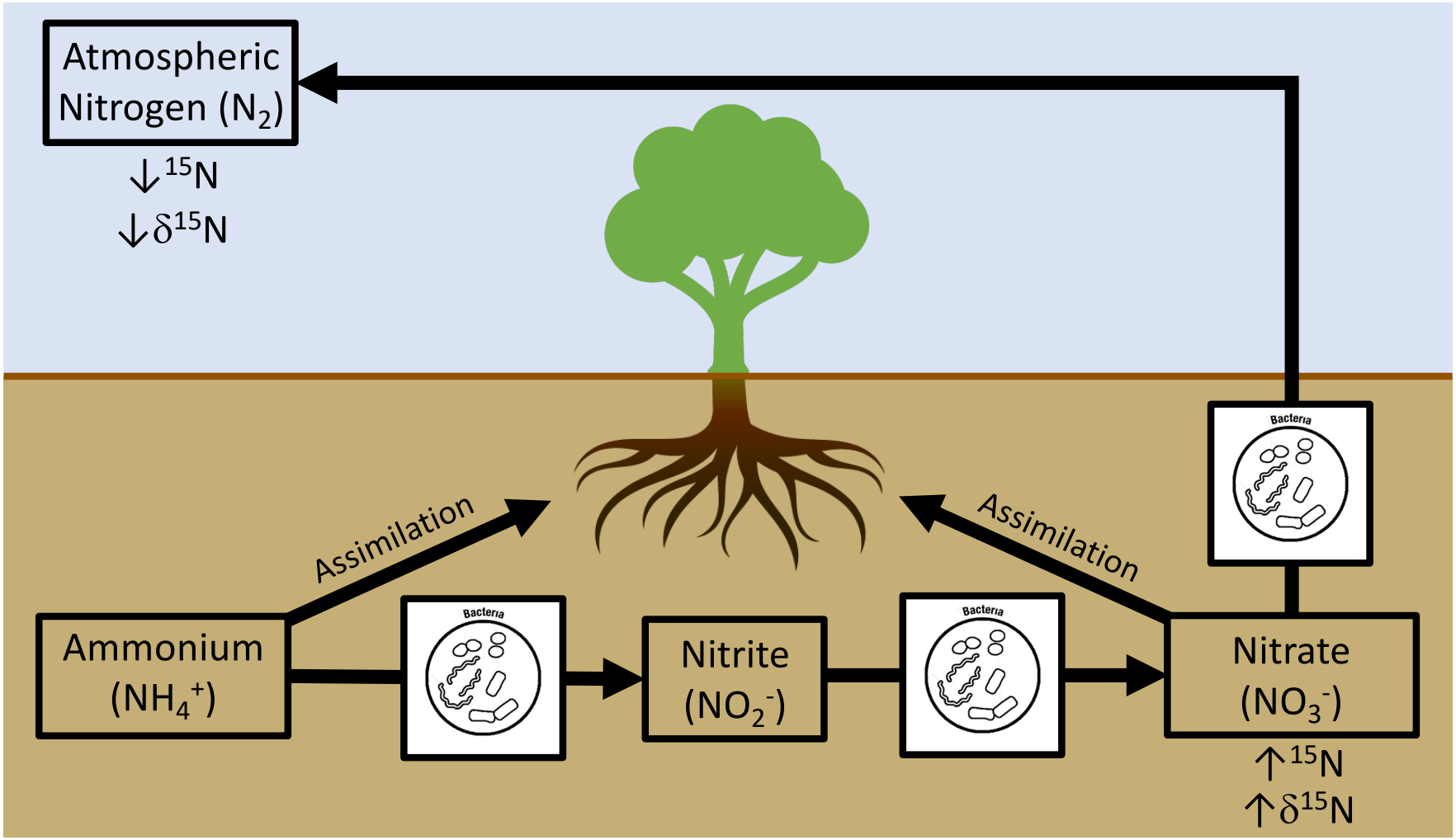
Denitrification: Lighter Goes Faster



The **reactant (nitrate)** contains more ^{15}N than the **product (N_2)**

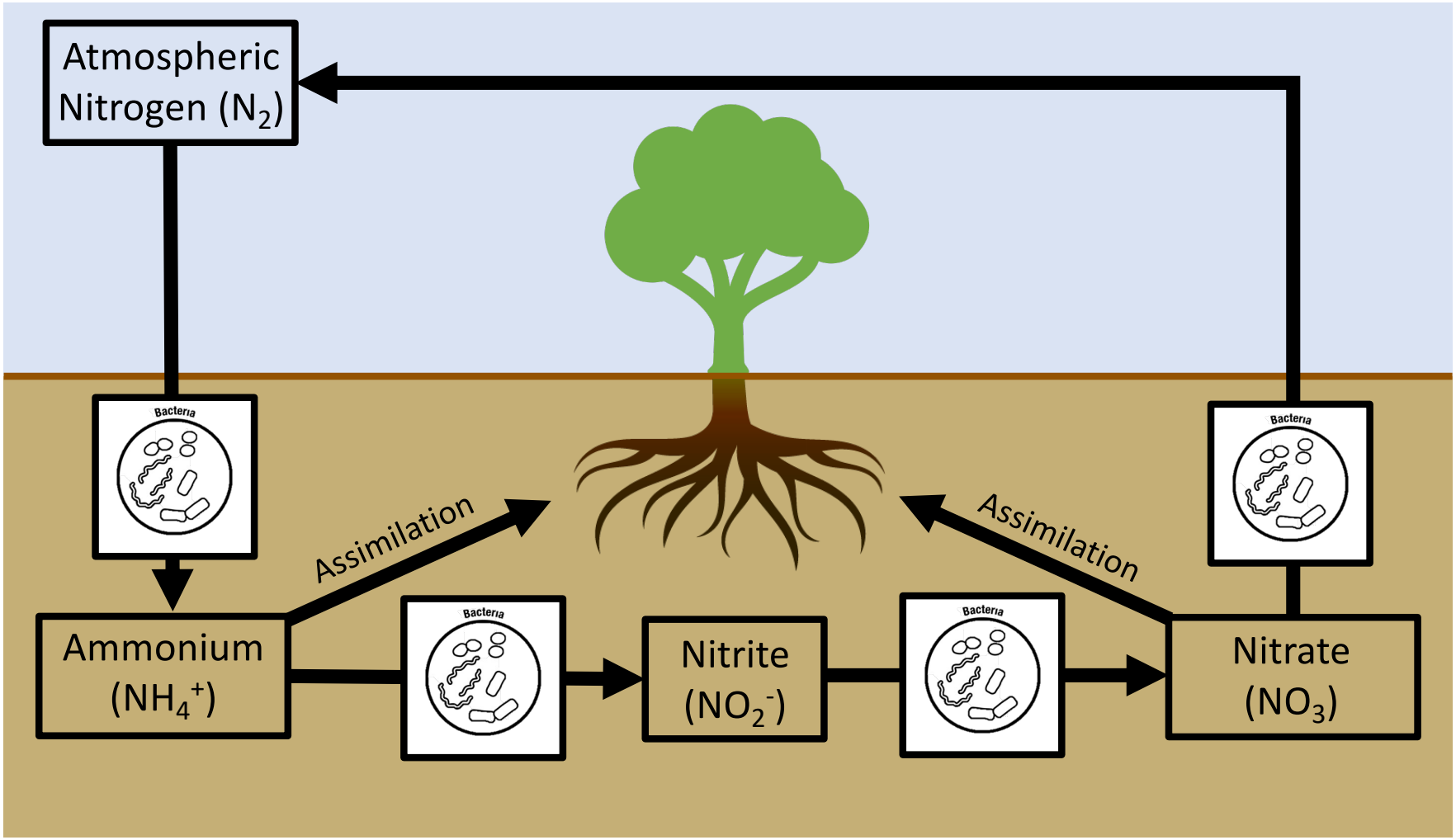
The **reactant (nitrate)** has a higher $\delta^{15}N$ value than the **product (N_2)**

Denitrification



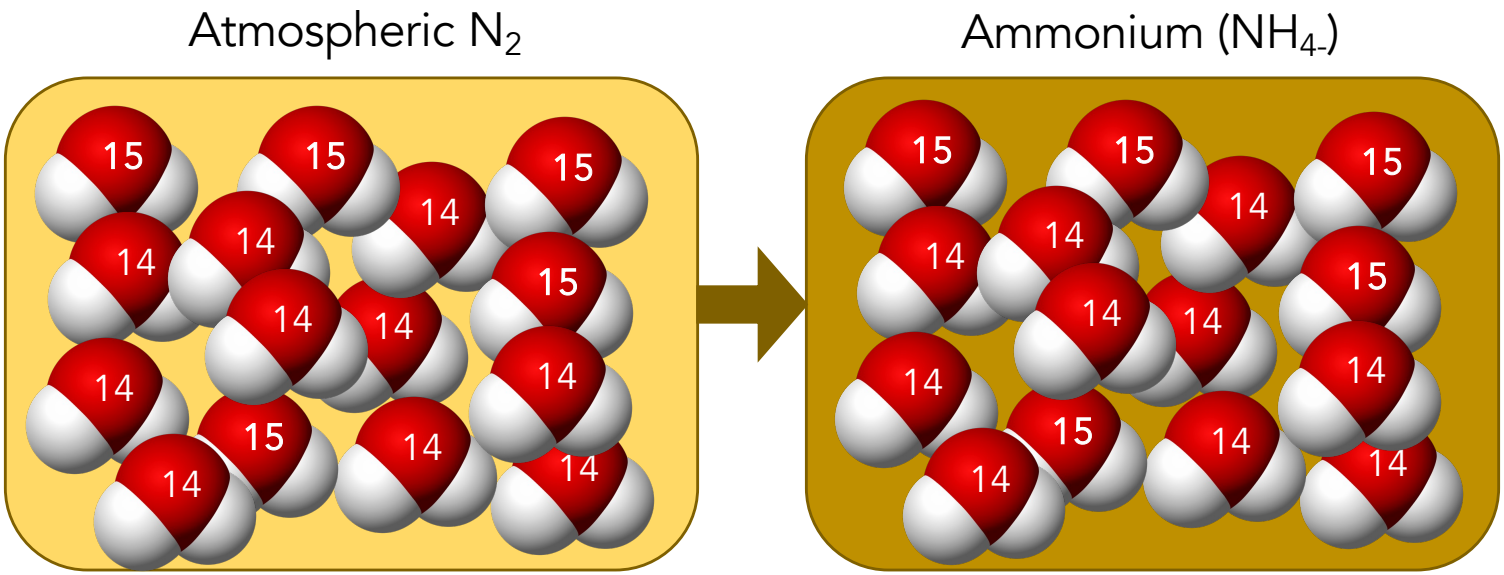
Nitrogen Fixation

$\delta^{15}N = 0‰$



Nitrogen Fixation

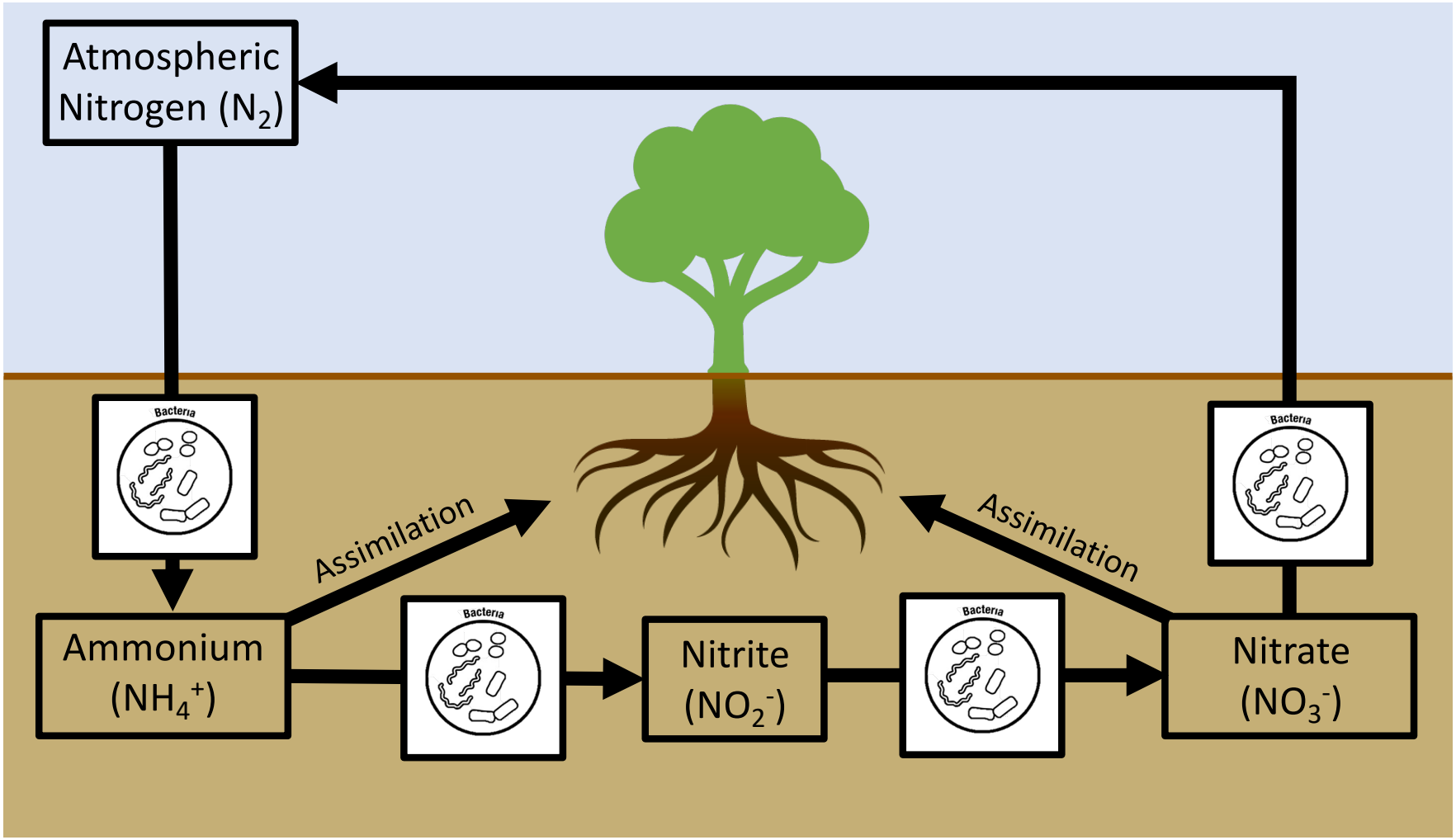
On land (in soils), N_2 fixation is mostly done by rhizobia (a type of bacteria)
In aquatic (marine and freshwater) ecosystems, it is mostly done by cyanobacteria



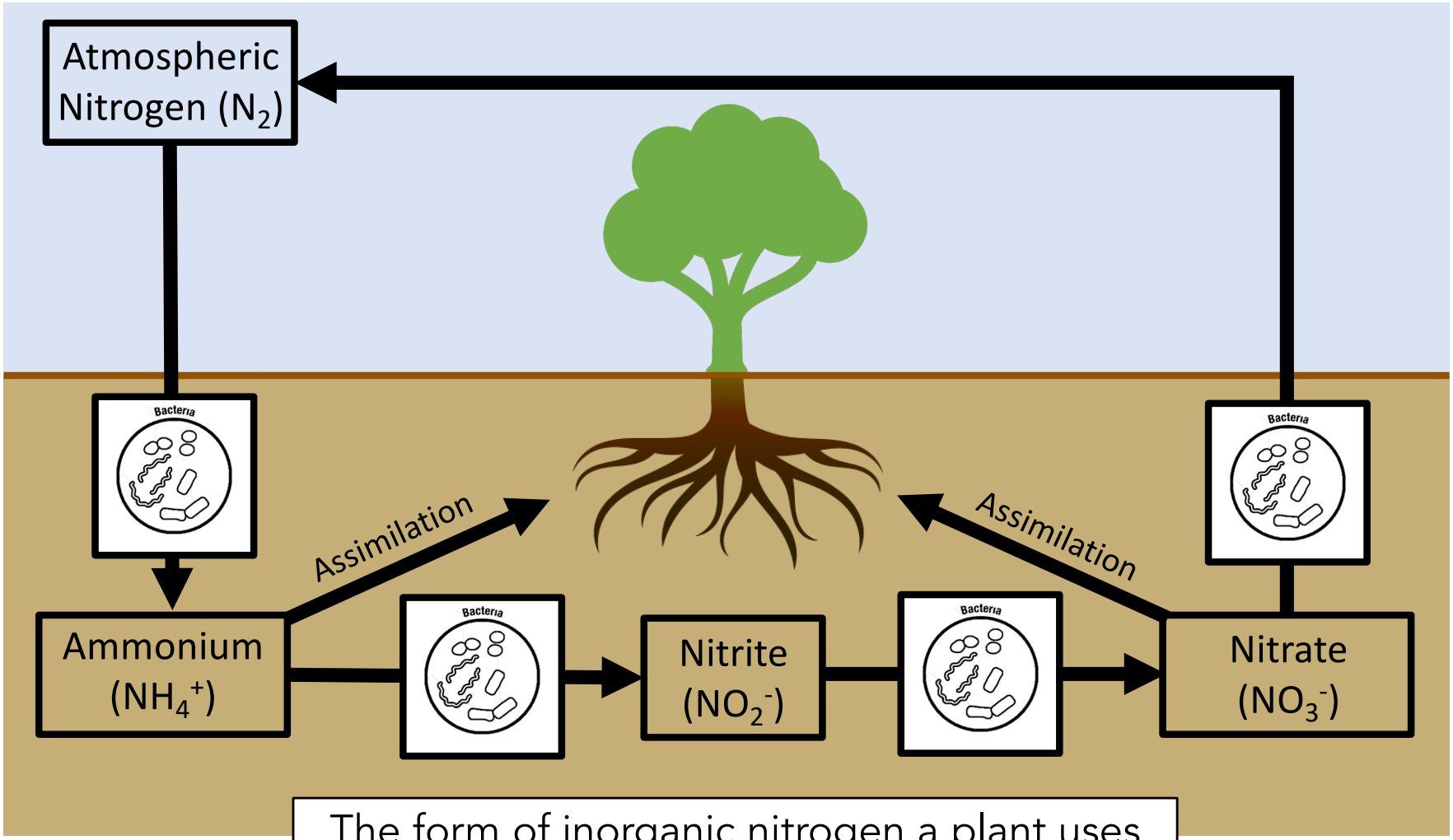
$\delta^{15}N$ = $\delta^{15}N$

Nitrogen Fixation

$\delta^{15}N = 0‰$

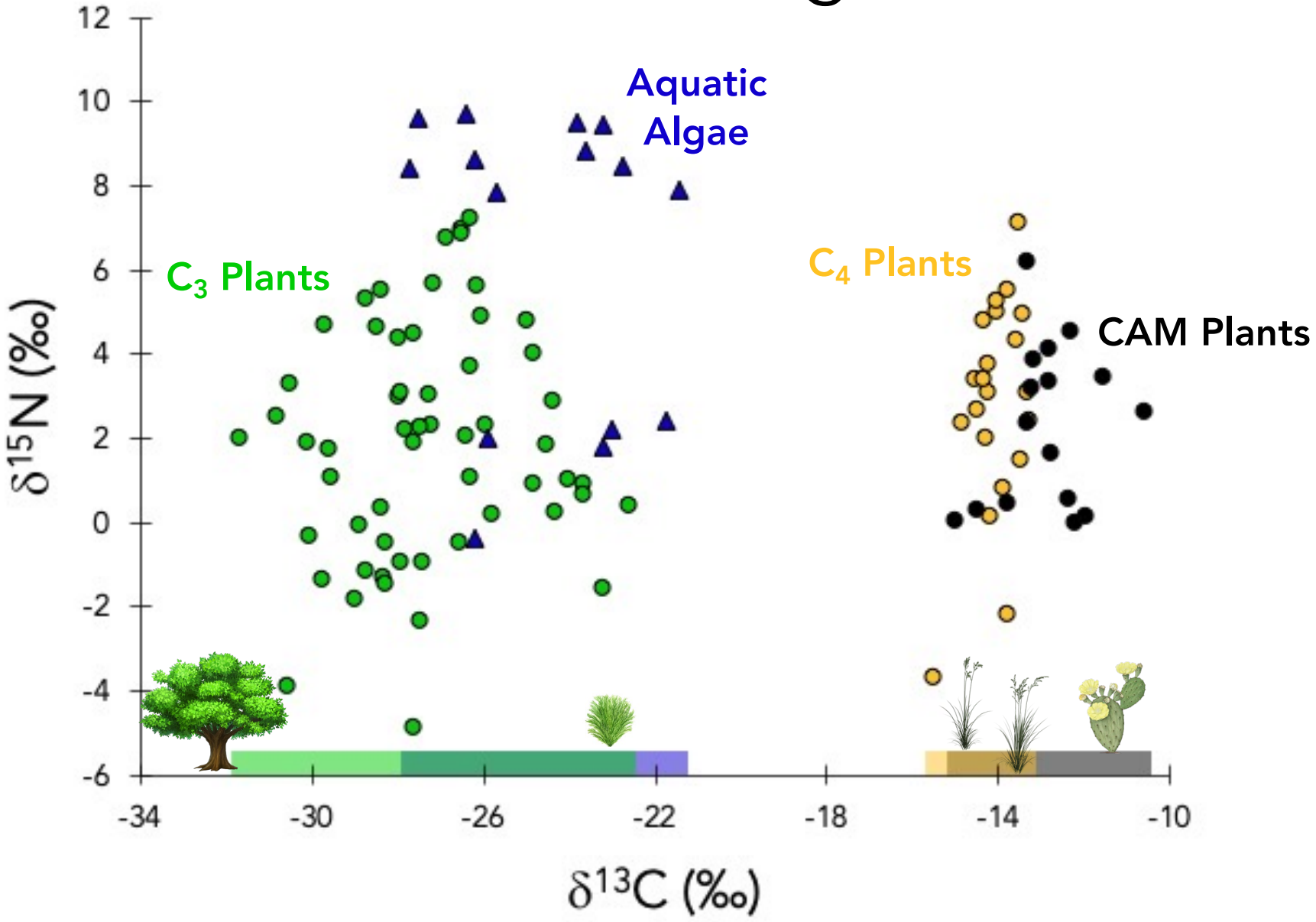


The Nitrogen Cycle



The form of inorganic nitrogen a plant uses strongly influences its $\delta^{15}N$ values!

Wide Range in $\delta^{15}N$ Values in New Mexican Plants and Algae!



Plant Nitrogen Take Home Points

- Transformations between different types of inorganic nitrogen produce the largest isotopic fractionations in the nitrogen cycle

- All of these transformations are done by bacteria **(microbes rule the world, and they certainly rule the nitrogen cycle)**

- During chemical transformations, lighter molecules (containing ^{14}N) move faster, resulting in lots of variation in $d^{15}N$ values of both the organic and inorganic pools of nitrogen