Nitrates (NO₃⁻)

- Taken into the atmosphere by denitrification.
- · Lost to leaching.
- Used by a plant to grow
- · Must travel with water

Nitrates (NO₃⁻)

- Taken into the atmosphere by denitrification.
- Lost to leaching.
- Used by a plant to grow
- · Must travel with water

Nitrates (NO₃⁻)

- Taken into the atmosphere by denitrification.
- · Lost to leaching.
- Used by a plant to grow
- Must travel with water

Nitrates (NO₃⁻)

- Taken into the atmosphere by denitrification.
- · Lost to leaching.
- Used by a plant to grow
- · Must travel with water

Nitrates (NO_{3⁻})

- Taken into the atmosphere by denitrification.
- · Lost to leaching.
- Used by a plant to grow
- · Must travel with water

Nitrates (NO_{3⁻})

- Taken into the atmosphere by denitrification.
- · Lost to leaching.
- Used by a plant to grow
- · Must travel with water

Nitrates (NO₃⁻)

- Taken into the atmosphere by denitrification.
- · Lost to leaching.
- Used by a plant to grow
- · Must travel with water

Nitrates (NO₃⁻)

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- Used by a plant to grow
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- Taken into the atmosphere by denitrification.
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- Used by a plant to grow

- Must travel with water

Nitrates (NO₃⁻)

- Taken into the atmosphere by denitrification.
- · Lost to leaching.
- Used by a plant to grow
- Must travel with water

- After visiting the nitrifying bacteria 2 (nitrobacter) you could be absorbed by a plant or released into the atmosphere.
- After visiting the nitrifying bacteria 2 (nitrobacter) you could be absorbed by a plant or released into the atmosphere.
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Ammonium (NH4⁺)

- Through **Nitrification** become a Nitrate (NO3⁻)
- Must travel with water
- Organic matter (animal manure/ plant residue) become Ammonium through **mineralization**

Ammonium (NH4⁺)

- Through **Nitrification** become a Nitrate (NO₃)
- Must travel with water
- Organic matter (animal manure/ plant residue) become Ammonium through **mineralization**

Ammonium (NH₄⁺)

- Through **Nitrification** become a Nitrate (NO₃-)
- Must travel with water
- Organic matter (animal manure/ plant residue) become Ammonium through **mineralization**

Ammonium (NH4⁺)

- Through **Nitrification** become a Nitrate (NO₃⁻)
- Must travel with water
- Organic matter (animal manure/ plant residue) become Ammonium through **mineralization**

Ammonium (NH4⁺)

- Through **Nitrification** become a Nitrate (NO₃⁻)
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- Organic matter (animal manure/ plant residue) become Ammonium through **mineralization**

Ammonium (NH4⁺)

- Through Nitrification become a Nitrate (NO₃⁻)
- Must travel with water
- Organic matter (animal manure/ plant residue) become Ammonium through **mineralization**

- Can go to plants, Nitrifying Bacteria 1 or denitrifying bacteria
- Can go to plants, Nitrifying Bacteria 1 or denitrifying bacteria
- Can go to plants, Nitrifying Bacteria 1 or denitrifying bacteria

- Can go to plants, Nitrifying Bacteria 1 or denitrifying bacteria
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- Can go to plants, Nitrifying Bacteria 1 or denitrifying bacteria
- Can go to plants, Nitrifying Bacteria 1 or denitrifying bacteria
- Can go to plants, Nitrifying Bacteria 1 or denitrifying bacteria

Nitrite (NO2)	Nitrite (NO2)	Nitrite (NO2)
Nitrite (NO2)	Nitrite (NO2)	Nitrite (NO2)
Nitrite (NO2)	Nitrite (NO2)	Nitrite (NO2)
Nitrite (NO2)	Nitrite (NO2)	Nitrite (NO2)
Nitrite (NO2)	Nitrite (NO2)	Nitrite (NO2)

- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO₃)
- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO $_3$)
- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO₃)

- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO₃)
- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO $_3$)
- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO₃)

- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO $_3$)
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- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO₃)

- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO $_3$)
- Find the nitrifying bacteria 2 (nitrobacter)
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- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO $_3$)

- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO₃)
- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO₃)
- Find the nitrifying bacteria 2 (nitrobacter)
- You must become a Nitrate (NO₃)

Water (H2O)	Water (H₂O)	Water (H2O)
Water (H2O)	Water (H₂O)	Water (H2O)
Water (H2O)	Water (H2O)	Water (H2O)
Water (H₂O)	Water (H₂O)	Water (H2O)

Water (H₂O)

Water (H₂O)

Water (H₂O)

- **Say:** *I* assist Ammonium and Nitrates where they need to go. Kind of like Uber.
- **Say:** I assist Ammonium and Nitrates where they need to go. Kind of like Uber.
- **Say:** I assist Ammonium and Nitrates where they need to go. Kind of like Uber.

- **Say:** I assist Ammonium and Nitrates where they need to go. Kind of like Uber.
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- **Say:** I assist Ammonium and Nitrates where they need to go. Kind of like Uber.
- **Say:** *I* assist Ammonium and Nitrates where they need to go. Kind of like Uber.

Plants	Plants	Plants
Plants	Plants	Plants
Plants	Plants	Plants
Plants	Plants	Plants

- You are stationary.
- May uptake $NH_{4^{^+}} \, or \, NO_3$
- Take an NH4⁺ or NO₃ card and hold it (immobilization) only if in the presence of water.
- Say: I use Ammonium (NH4⁺) or Nitrates (NO3-) to grow. Thank you! Nitrogen is now stuck here until I decompose.
- You are stationary.
- May uptake NH₄⁺ or NO₃
- Take an NH4⁺ or NO₃ card and hold it (immobilization) only if in the presence of water.
- Say: I use Ammonium (NH4⁺) or Nitrates (NO3-) to grow. Thank you! Nitrogen is now stuck here until I decompose.
- You are stationary.
- May uptake NH₄⁺ or NO₃
- Take an NH4⁺ or NO₃ card and hold it (immobilization) only if in the presence of water.
- Say: I use Ammonium (NH4⁺) or Nitrates (NO3⁻) to grow. Thank you! Nitrogen is now stuck here until I decompose.
- You are stationary.
- May uptake NH4⁺ or NO3
- Take an NH4⁺ or NO₃ card and hold it (immobilization) only if in the presence of water.
- **Say:** I use Ammonium (NH₄⁺) or Nitrates (NO₃-) to grow. Thank you! Nitrogen is now stuck here until I decompose.
- You are stationary.
- May uptake NH₄⁺ or NO₃
- Take an NH4⁺ or NO₃ card and hold it (immobilization) only if in the presence of water.
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- You are stationary.
- May uptake NH4⁺ or NO3
- Take an NH4⁺ or NO₃ card and hold it (immobilization) only if in the presence of water.
- **Say:** I use Ammonium (NH₄⁺) or Nitrates (NO₃-) to grow. Thank you! Nitrogen is now stuck here until I decompose.
- You are stationary.
- May uptake NH4⁺ or NO3
- Take an NH4⁺ or NO₃ card and hold it (immobilization) only if in the presence of water.
- **Say:** I use Ammonium (NH₄⁺) or Nitrates (NO₃-) to grow. Thank you! Nitrogen is now stuck here until I decompose.
- You are stationary.
- May uptake NH_4^+ or NO_3
- Take an NH4⁺ or NO₃ card and hold it (immobilization) only if in the presence of water.
- Say: I use Ammonium (NH₄⁺) or Nitrates (NO₃-) to grow. Thank you! Nitrogen is now stuck here until I decompose.
- You are stationary.
- May uptake $NH_{4^{+}}$ or NO_{3}
- Take an NH4⁺ or NO₃ card and hold it (immobilization) only if in the presence of water.
- **Say:** I use Ammonium (NH₄⁺) or Nitrates (NO₃-) to grow. Thank you! Nitrogen is now stuck here until I decompose.

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- You are stationary.
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- You are stationary.
- May uptake NH₄⁺ or NO₃
- Take an NH4⁺ or NO₃ card and hold it (immobilization) only if in the presence of water.
- Say: I use Ammonium (NH4⁺) or Nitrates (NO3⁻) to grow. Thank you! Nitrogen is now stuck here until I decompose.
- You are stationary.
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- Say: I use Ammonium (NH4⁺) or Nitrates (NO3⁻) to grow. Thank you! Nitrogen is now stuck here until I decompose.

- You are stationary.
- May uptake NH4⁺ or NO3
- Take an NH4⁺ or NO₃ card and hold it (immobilization) only if in the presence of water.
- Say: I use Ammonium (NH₄⁺) or Nitrates (NO₃-) to grow. Thank you! Nitrogen is now stuck here until I decompose.
- You are stationary.
- May uptake NH_4^+ or NO_3
- Take an NH4⁺ or NO3 card and hold it (immobilization) only if in the presence of water.
- Say: I use Ammonium (NH4⁺) or Nitrates (NO3-) to grow. Thank you! Nitrogen is now stuck here until I decompose.

Atmospheric Nitrogen (N₂) Atmospheric Nitrogen (N₂) Atmospheric Nitrogen (N₂)

Atmospheric Nitrogen (N₂) Atmospheric Nitrogen (N₂) Atmospheric Nitrogen (N₂)

Atmospheric Nitrogen (N₂) Atmospheric Nitrogen (N₂) Atmospheric Nitrogen (N₂)

Atmospheric Nitrogen (N₂) Atmospheric Nitrogen (N₂) Atmospheric Nitrogen (N₂)

Atmospheric Nitrogen (N₂) Atmospheric Nitrogen (N₂) Atmospheric Nitrogen (N₂)

- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.
- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.
- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.

- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.
- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.
- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.

- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.
- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.
- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.

- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.
- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.
- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.

- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.
- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.
- **Say:** I just got out of the cycle. I am just hanging out up here waiting for a legume plant or some lightning to fix me to something.
- Go to a nitrogen-fixing bacteria to get back in the cycle.

Nitrogen-fixing bacteria (Free-living or rhizobia/cyanobacteria)

- Change N2 into NH4+
- Take an N2 card and give an NH4+ card

Nitrogen-fixing bacteria (Free-living or rhizobia/cyanobacteria)

- Change N2 into NH4+
- Take an N2 card and give an NH4+ card

Nitrogen-fixing bacteria (Free-living or rhizobia/cyanobacteria)

- Change N2 into NH4+
- Take an N2 card and give an NH4+ card

Nitrogen-fixing bacteria (Free-living or rhizobia/cyanobacteria)

- Change N2 into NH4+
- Take an N2 card and give an NH4+ card

Nitrogen-fixing bacteria (Free-living or rhizobia/cyanobacteria)

Change N2 into NH4+
Take an N2 card and give an NH4+ card

Nitrogen-fixing bacteria (Free-living or rhizobia/cyanobacteria)

- Change N2 into NH4+
- Take an N2 card and give an NH4+ card

- You are stationary.
- Say: I remove Nitrogen from the atmosphere and change it into Ammonium (NH4⁺)
- You are stationary.
- **Say:** I remove Nitrogen from the atmosphere and change it into Ammonium (NH4⁺)
- You are stationary.
- **Say:** I remove Nitrogen from the atmosphere and change it into Ammonium (NH4⁺)

- You are stationary.
 Say: I remove Nitrogen from the atmosphere
- **Say:** I remove Nitrogen from the atmosphere and change it into Ammonium (NH $_4^+$)
- You are stationary.
- Say: I remove Nitrogen from the atmosphere and change it into Ammonium (NH4⁺)
- You are stationary.
 Sav: I remove Nitrogen from the
- Say: I remove Nitrogen from the atmosphere and change it into Ammonium (NH4⁺)

rifying bacteria 1	Vitrosomonas)
Nitrif	(Nit

- Change $NH_{4^{+}}$ into NO_{2}
- Take a NH4⁺ card and give an NO₂ card

Nitrifying bacteria 1 (Nitrosomonas)

- Change NH⁴⁺ into NO²
- Take a NH4⁺ card and give an NO₂ card

Nitrifying bacteria 1 (Nitrosomonas)

- Change NH⁴⁺ into NO²
- Take a NH4⁺ card and give an NO₂ card

Nitrifying bacteria 1 (Nitrosomonas)

Change NH4⁺ into NO2
Take a NH4⁺ card and give an NO2 card

Nitrifying bacteria 1 (Nitrosomonas)

- Change NH_4^+ into NO_2
- Take a NH4⁺ card and give an NO₂ card

Nitrifying bacteria 1 (Nitrosomonas)

- Change NH₄⁺ into NO²
- Take a NH^{4^+} card and give an NO_2 card

 Say: I convert Ammonium (NH⁴⁺) into Nitrous Oxide (NO²) You are stationary.

- You are stationary.
- Say: I convert Ammonium (NH⁴⁺) into Nitrous Oxide (NO²)

- You are stationary.
- Say: I convert Ammonium (NH⁴⁺) into Nitrous Oxide (NO²)

 Say: I convert Ammonium (NH4⁺) into Nitrous Oxide (NO2) You are stationary.

 Say: I convert Ammonium (NH⁴⁺) into Nitrous Oxide (NO2) You are stationary.

 Say: I convert Ammonium (NH⁴⁺) into Nitrous Oxide (NO²) You are stationary.

Denitrifying bacteria

- Change NH⁴⁺, NO₂ and NO₃ back into N₂
 Take any N₋ card and give an N₂ card

Denitrifying bacteria

- Change NH4 $^{+}$, NO2 and NO3 back into N2 - Take any N_ card and give an N2 card

Denitrifying bacteria

- Change NH4⁺, NO2 and NO3 back into N2 Take any N_ card and give an N2 card

Denitrifying bacteria

- Change $NH_4^+,\,NO_2$ and NO_3 back into N_2
- Take any N_ card and give an N $_2$ card

Denitrifying bacteria

- Change $NH^{\rm 4^+},$ NO_2 and NO_3 back into N_2 • Take any N_card and give an N2 card

Denitrifying bacteria

- Change $NH_4^+,\,NO_2$ and NO_3 back into N_2
 - Take any N_ card and give an N $_2$ card

- You are stationary.
- Say: I release Nitrogen back into the atmosphere
- You are stationary.
- Say: I release Nitrogen back into the atmosphere
- You are stationary.
- Say: I release Nitrogen back into the atmosphere

- You are stationary.
- Say: I release Nitrogen back into the atmosphere
- Say: I release Nitrogen back into the atmosphere You are stationary.
- You are stationary.
- Say: I release Nitrogen back into the atmosphere