The Nitrogen Cycle

Mohammad Khan, GK-12 Resident Scientist

What is the Nitrogen Cycle?

- The cycle describes how Nitrogen moves between plants, animals, bacteria, humans, atmosphere, and soil in the ground.
- Nitrogen is an important element to all life on Earth.
- Part of biogeochemical (processes in which inorganic molecules are recycled in an ecosystem) cycle.

Terminology

- **Fixation**- first step in the process of making nitrogen usable by plants. Here bacteria change nitrogen to ammonium (NH_4^+).

- **Nitrification**- this is where ammonium gets changed into nitrates by bacteria (Nitrates is what plants are able to absorb).

Terminology

- **Assimilation**- This is how plants get nitrogen. They absorb nitrates from soil into their roots. Nitrogen then used in amino acids, nucleic acids, and chlorophyll.
- **Ammonification**- Decaying process (when plant or animal dies), decomposers like fungi and bacteria turn nitrogen back into ammonium so it can re-enter the nitrogen cycle.
- **Denitrification**- excess nitrogen in soil gets put back out into the air (special bacteria that perform this task).

Overall reaction

Nitrite Production:

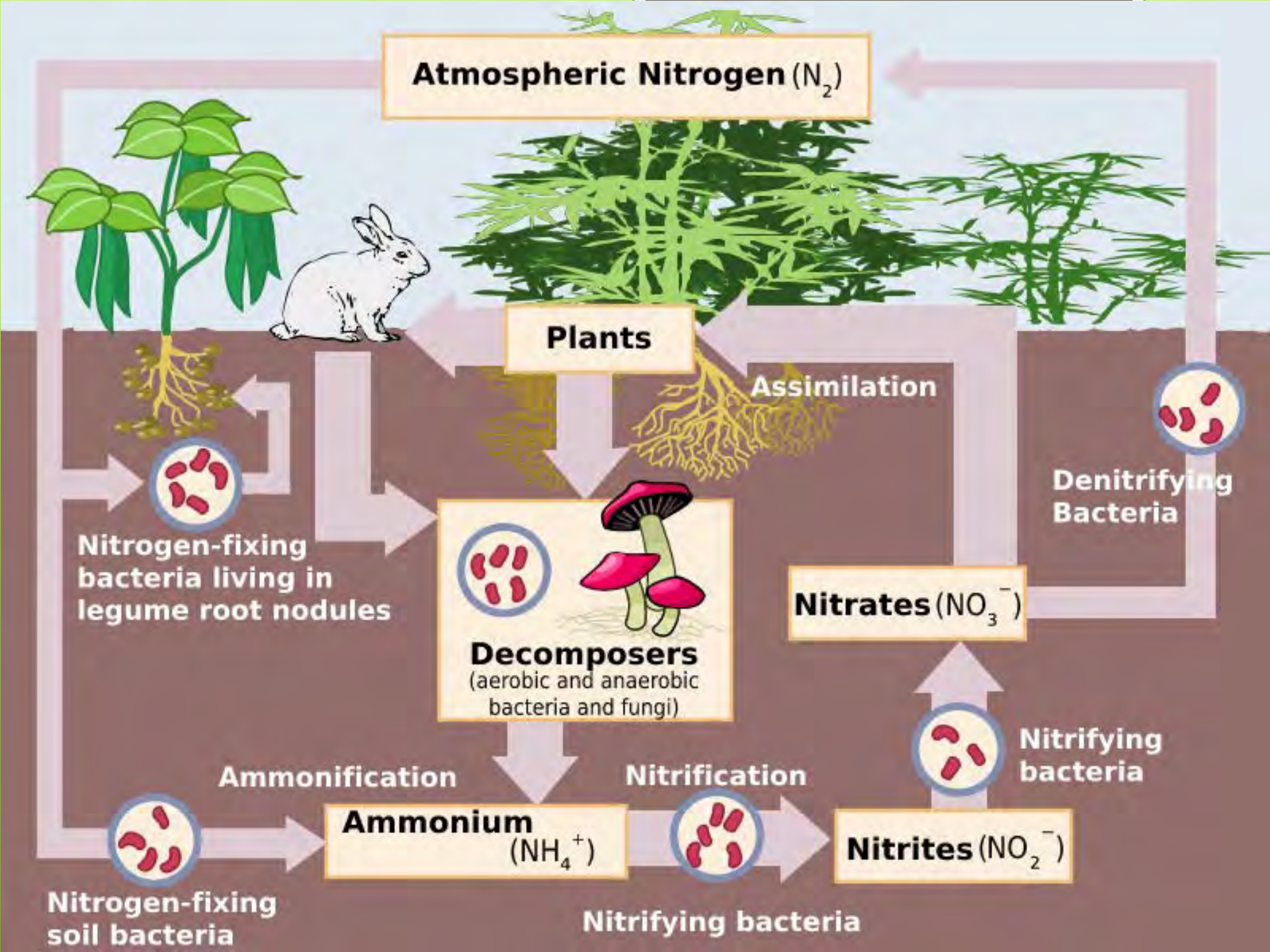
$NH_4^+ + 2O_2 \rightarrow NO_2^- + 2H_2O$

Nitrate Production (readily taken up by plants):

$2NO_2^- + O_2 \rightarrow 2NO_3^-$

Why is Nitrogen important?

- Important to many cellular process such as:
  - Synthesis (making) of amino acids, proteins, and DNA.
- Important to synthesize chlorophyll in plants, which plants use for photosynthesis to make their food and energy.


Atmospheric Nitrogen (N_2)
Plants
Assimilation
Denitrifying Bacteria
Nitrogen-fixing bacteria living in legume root nodules
Decomposers
(aerobic and anaerobic bacteria and fungi)
Nitrates (NO_3^-)
Nitrifying bacteria
Ammonification
Nitrification
Ammonium (NH_4^+)
Nitrites (NO_2^-)
Nitrogen-fixing soil bacteria
Nitrifying bacteria

Video

- http://www.youtube.com/watch?v=ZaFVfHftzpI

Fun Facts!

- Nitrous oxide is a greenhouse gas. Too much of it can cause acid rain.
- Nitrogen has no color, odor, or taste.
- It is used in many explosives.
- About 3% of your body weight is nitrogen.

- Nitrogen Cycle Experiment

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Nitrogen Cycle Experiment

In this activity, you will construct a working model of the nitrogen cycle using the materials provided by us. Working as a group, discuss and design a model that will supply all the missing parts needed to complete the nitrogen cycle. Once the group has an idea of how the setup is going to be, present the set up to us, and be prepared to justify why the group chose this specific setup method. Once the setup is approved, set up and run your respective model. Monitor and record the ammonia, nitrite and nitrate levels regularly (every other day these tests will be carried out). Record all relevant data and observations, including fish and plant mortalities, water coloration changes, fish behavioral changes, and growth of plants, including roots.

Questions to think about:

1. What are you testing in your experiment? What are you trying to find out?
2. What do you think will happen? Why do you think so?
3. What are you going to use to find out the answer to the question?
4. What are you going to do? How are you going to do it?
5. What data will you record and how will you collect and present it?
6. What happened? Did you observe anything that surprised you?

Ammonia Test Procedure:

1. Pipette 5mL of tank water into a test tube.
2. Add 8 drops from Ammonia Test Bottle #1.
3. Cap the test tube and shake for 5 seconds.
4. Wait 5 minutes.
5. Compare color in test tube to color on Ammonia Level Card. Record your value.

Nitrite Test

1. Pipette 5mL of tank water into a test tube.
2. Add 5 drops from Nitrite Test Bottle.
3. Cap and shake test tube for 5 seconds.
4. Wait 5 minutes.
5. Compare color in test tube to color on Nitrite level card. Record your value

Nitrate Test

1. Pipette 5mL of tank water into a test tube.
2. Add 10 drops from Nitrate Test Bottle #1.
3. Cap and shake test tube for 5 seconds.
4. Shake Nitrate Test Bottle #2 vigorously for 30 seconds.
5. Add 10 drops from Nitrate Test Bottle #2.
6. Wait 5 minutes.
7. Compare color in test tube to color on Nitrate Level Card. Record your value.

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Results Chart

	Ammonia Test Result	**Nitrite Test Result**	**Nitrate Test Result**
Day 1			
Day 3			
Day 5			
Day 7			
Day 9			

Questions to Answer:

1. What would happen to each tank without the nitrogen cycle, and why?

2. Do fish produce nitrogen? If not, where does the nitrogen found in fish come from?

3. What was added to the system? If this were a closed system, how would it differ?

4. What happens to pH levels as ammonia is converted to nitrate?

5. Besides ammonia, what else needs to be present for the nitrification process to work?

6. What conclusions can you draw based upon the results of your experiment? How does this compare with your initial hypothesis? If given the opportunity, how might you conduct the experiment differently?

7. Humans have altered the influx of nitrogen at different stages of the nitrogen cycle. Pick one way in which this happens and explain what the long-term effects may be on the environment?

Nitrogen Cycle Experimental Setup

Example Template:

Remember this might not be right order for your set up.

½ full with Water

Tank II:
-5-10 Gold Fish
-Feed Fish VERY small amount of food.

½ full with Water

Tank I:
-2 Foam Quads with cotton, soil, and seeds. Place two seeds in each well.

Tank III:
-Add DISTELLED Water.
-Add one capful of Start Zyme (Bacteria).
-Add Pebbles to this tank (only enough to cover the bottom of the aquarium.

Tank I	Tank II	Tank III
Plants	Fish	Bacteria

Equipment Provided (per group):

- 3 tanks
- 1 water pump
- 1 water tube
- 2 foam quads
- Seeds
- Pebbles
- Cotton
- 3 large blocks
- 5-8 small wooden sticks

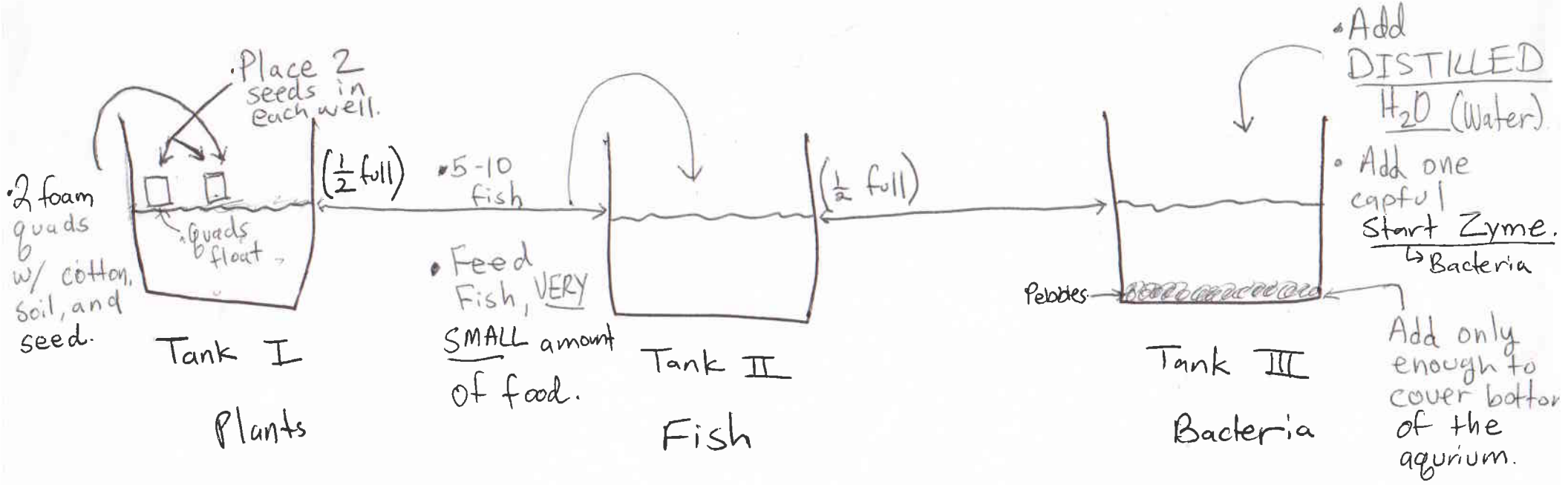
Tests that need to be done:

- Ammonia Test
- Nitrite Test
- Nitrate Test

Nitrogen Cycle

example:

(Remember this might not be right order for your setup).



- Equipment Provided
  - → 3 tanks
  - → 1 water pump
  - → 1 water tube
  - → 2 foam quads
  - → seeds
  - → Pebbles
  - → Cotton
  - → 3 large blocks
  - → 3-5 small wooden Sticks (more available)

Tests

- Ammonia Test
- Nitrate Test (Nitrite Test)
- Nitrate Test