

## Nitrogen Cycle in the Aquarium

Target Audience: Aquarium/Fish 6-8 Grade science

**Learning Goal:** Students will be able to identify how the nitrogen cycle effects the fish's environment.

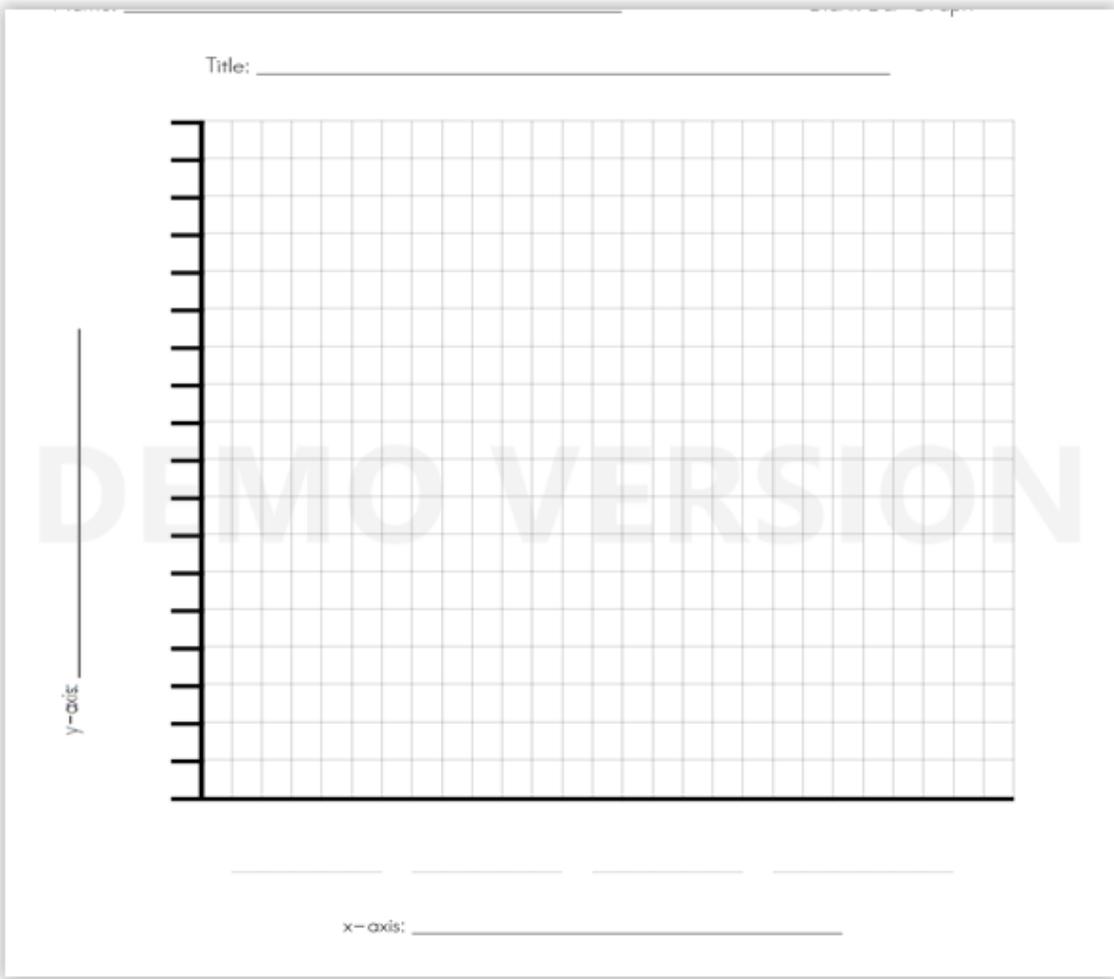
Day 1: Students will read background information about the nitrogen cycle in the water and take cornell style notes and draw an example of the nitrogen cycle in an aquarium.

Day 2: Students will complete a water test of 3 different aquariums and graph their results. Aquarium 1: newly set up aquarium (less than a week), Aquarium 2: aquarium that has been set up for less than a year, Aquarium 3: an aquarium that has been set up more than a year (you can usually consult your local pet store and get some of the water from their system).

Step 1: Students will get a small sample of each type of water (make sure they label their beakers).

Step 2: Students will test each aquarium for nitrates, nitrites, and ammonia using aquarium testing kits or aquarium dip testing kits. Students will record results in the provided table and then create a graph.

<b>Aquarium #</b>	<b>Nitrates</b>	<b>Nitrites</b>	<b>Ammonia</b>
<b>1</b>			
<b>2</b>			
<b>3</b>			



Step 3: Answer the conclusion questions.

1. What pattern do you notice between the ammonia levels and the nitrate levels?

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2. What pattern do you notice between the ammonia levels and the nitrite levels?

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3. What pattern do you notice between the nitrate levels and nitrite levels?

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4. How do you know the nitrogen cycle is occurring in the different fish tanks?

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5. Which tank is best for the fish? Why do you think that is (use information from the background reading)?

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# Aquarium Nitrogen Cycle

Adapted from <http://www.fishlore.com/NitrogenCycle.htm>

## Nitrogen Cycle Overview

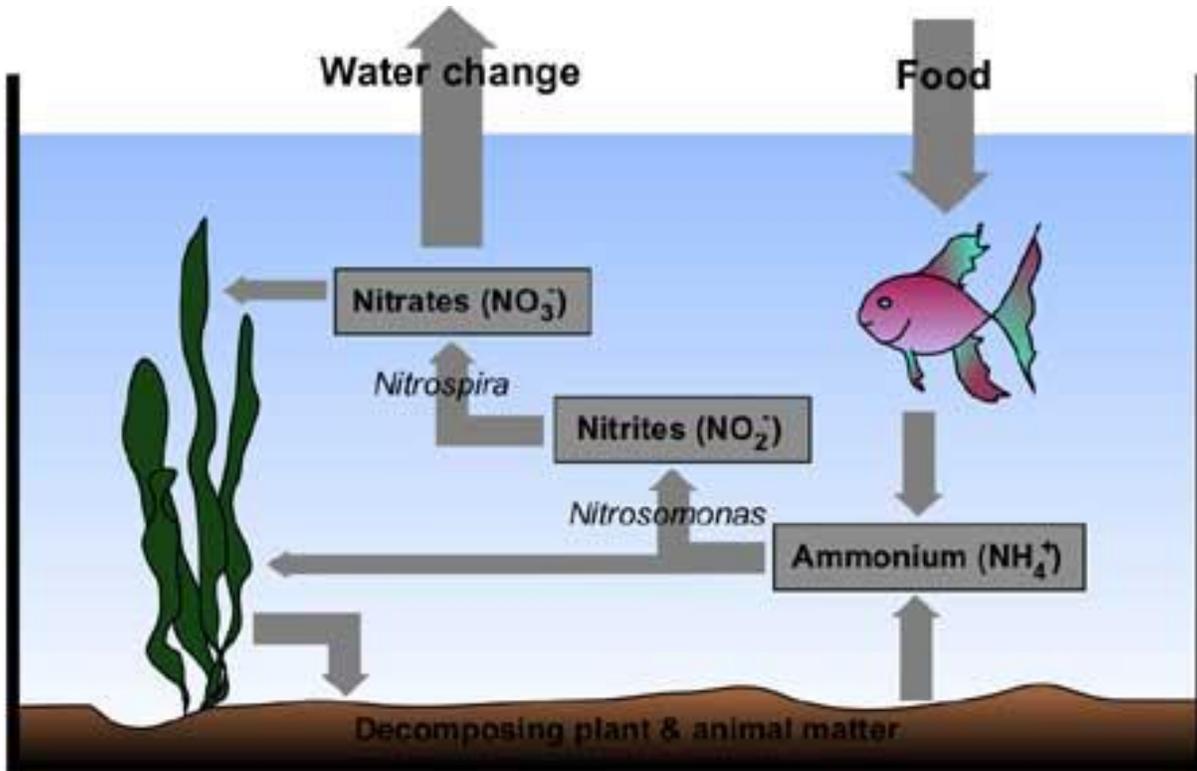
The aquarium nitrogen cycle information presented below may be rather boring to most people, but it is absolutely essential to understand this process if you want to be successful at keeping fish!

Some call it the biological cycle, the nitrification process, new tank syndrome or even the start-up cycle. They all are referring to the same cycle - The Nitrogen Cycle. The aquarium nitrogen cycle is a very important process for the establishment of beneficial bacteria in the aquarium and in the filter media that will help in the conversion of ammonia to nitrite and then the conversion of nitrite to nitrates. Check out the aquarium water chemistry page (on the left) for more information on these terms.

This process can take from 2 weeks to 2 months or longer to complete. It is vital for anyone planning on keeping aquarium fish to understand this process. Learning about this process will help you to be successful in keeping fish and it should definitely improve your chances when keeping tropical fish. The best way to monitor the nitrogen cycle is to purchase an aquarium test kit that will test for ammonia, nitrites, nitrates and ph.

Test your aquarium water every other day and write down your readings. You will first see ammonia levels rising. A few weeks or so later you should see the nitrite levels rising and the ammonia levels dropping. Finally, after a few more weeks you should see the nitrate levels rising and the nitrite levels dropping. When you no

longer detect ammonia or nitrites but you can detect nitrates you can assume that it is safe to add your tropical fish.



[Pinit](#)

Photo Credit: Ilmari Karonen

## Nitrogen Cycle Stages

### Stage 1

Ammonia is introduced into the aquarium via tropical fish waste and uneaten food. The tropical fish waste and excess food will break down into either ionized ammonium (NH<sub>4</sub>) or un-ionized ammonia (NH<sub>3</sub>). Ammonium is not harmful to tropical fish but ammonia is. Whether the material turns into ammonium or ammonia depends on the pH level of the water. If the pH is under 7, you will have ammonium. If the pH is 7 or higher you will have ammonia.

### Stage 2

Soon, bacteria called nitrosomonas will develop and they will oxidize the ammonia in the tank, essentially eliminating it. The byproduct of ammonia oxidation is Nitrites. So we no longer have ammonia in the tank, but we now have another toxin to deal with - Nitrites. Nitrites are just as toxic to tropical fish as ammonia. If you have a test kit, you should be able to see the nitrite levels rise around the end of the first or second week.

### Stage 3

Bacteria called nitrobacter will develop and they will convert the nitrites into nitrates. Nitrates are not as harmful to tropical fish as ammonia or nitrites, but nitrate is still harmful in large amounts. The quickest way to rid your aquarium of nitrates is to perform partial water changes. Once your tank is established you will need to monitor your tank water for high nitrate levels and perform partial water changes as necessary.

There are other methods to control nitrates in aquariums besides water changes. For freshwater fish tanks, live aquarium plants will use up some of the nitrates. In saltwater fish tanks, live rock and deep sand beds can have

anaerobic areas where denitrifying bacteria can breakdown nitrates into harmless nitrogen gas that escapes through the water surface of the aquarium.

## Starting the Cycle - Cycling With And Without Fish

### Starting The Nitrogen Cycle With Fish

This is not the preferred way to get the nitrogen cycle started because the fish are being exposed to ammonia and nitrites during this process. Many fish can not and will not make it through the cycling process. Often times the fish become stressed and fish disease starts to break out. I wonder what percentage of disease is caused by the cycling of new aquariums?

Certain fish species are hardier than others and seem to tolerate the start-up cycle better than others. For freshwater tanks, the zebra danio is a very hardy fish that many use to get the nitrogen cycle started. For saltwater tanks, some have reported success using damselfish to get the process started. Again, using fish to cycle is not a good idea and you may be throwing your money (on dead fish) out the window. There is a better way. Read on, young grasshopper.

### Starting The Nitrogen Cycle Without Fish

There are a few different ways to get this process started. To easily get an ammonia reading from your tank water try the Seachem Ammonia Alert. It sticks inside the tank and has a circle that changes color depending on the ammonia levels in the tank. It doesn't seem to have the most accurate measurement so you would need to get a good liquid ammonia test kit to get a more accurate reading of the ammonia levels in your tank.

Once the cycle has started only add one or two fish at a time. Wait a couple of weeks before adding more fish. This will give your tank the time it needs to catch up with the increased bio-load.

### Speeding Up the Cycling Process

There are things you can do to speed along the process of cycling your aquarium.

- Increase the temperature of your aquarium water to 80°F-82°F (27°C-28°C)
- Get some beneficial bacteria colonies. Borrow some gravel from an established and cycled aquarium. If you have another tank with an extra filter you can use it. If you have a really nice friend with an established and cycled aquarium, ask if you can have one of their used filter media. It will be loaded with the good bacteria that we are looking for.
- There are products on the market that claim to introduce the beneficial bacteria. For more information, check out products like Bio-spira and Tetra SafeStart in option 6 above. There are many more products entering the market that contain the beneficial bacteria necessary to seed your tank. Between live rock (for saltwater aquariums) and the bottled bacteria being readily available, there really is no excuse to make fish suffer through a cycle.