

**Can-U-Read**

**Aquarium Health &  
the Nitrogen Cycle**

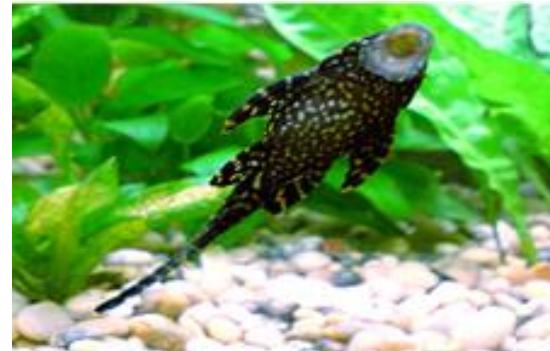
Maintaining an aquarium is a complicated process. The aquarium has to deal with all the chemistry of living things in a contained environment. The limited biosphere prevents the free exchange of chemicals with the wider environment.

Things that naturally work themselves out in the wild become deadly problems in an aquarium. To fix these problems, you need to understand the chemistry involved.



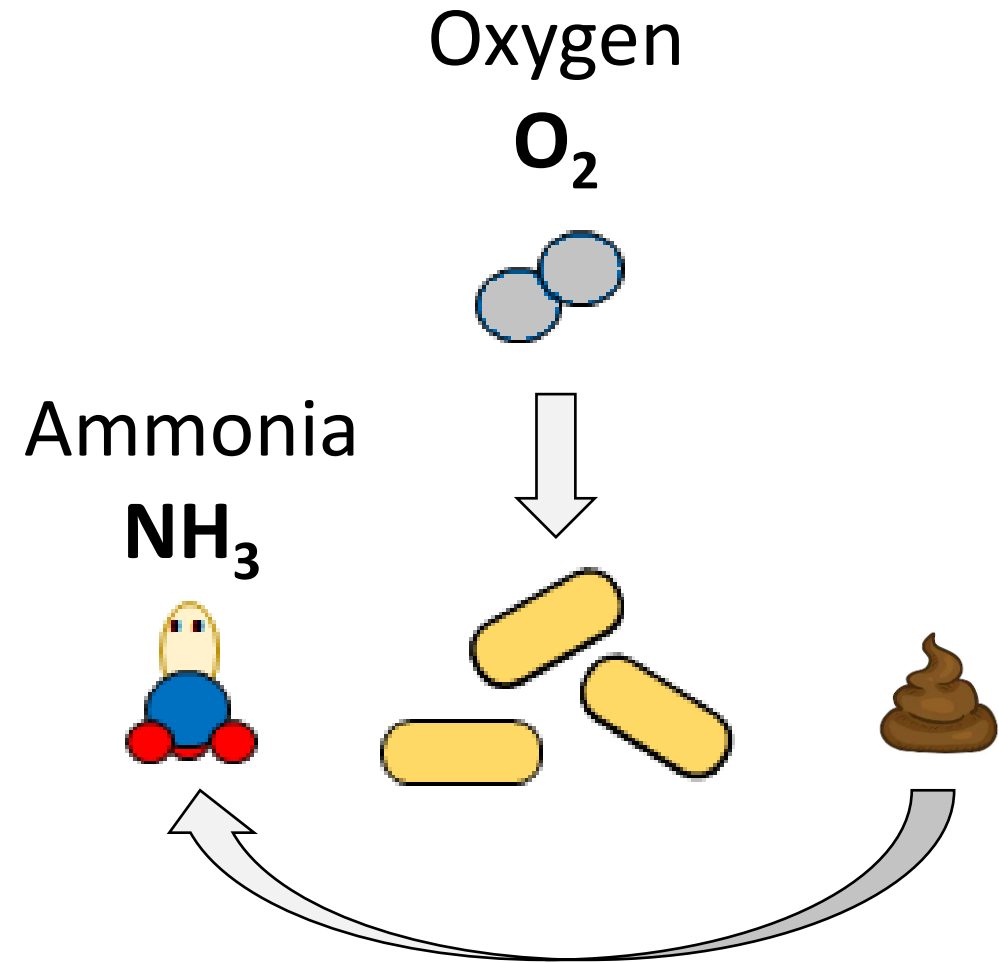
All living things create waste either by pooping or by dying. Plants and animals both leave behind their bodies to decompose. Uneaten food spoils and decomposes, too. All of this material becomes food to the decomposers.

If an aquarium has decomposers, the build up of dead matter can be slowed, but it still happens. Getting rid of the dead matter becomes your job.



Everything not eaten by the decomposers (or left by them) becomes food for aerobic bacteria. Aerobic means “using oxygen”. These bacteria use oxygen to “burn” their food and release energy.

Aerobic bacteria release ammonia as a waste product. Ammonia is pretty smelly. It is the reason why toilets smell so bad.





Uneaten fish food and poop settle to the bottom of the tank. This is where aerobic bacteria like to live. This is where they turn waste into ammonia.

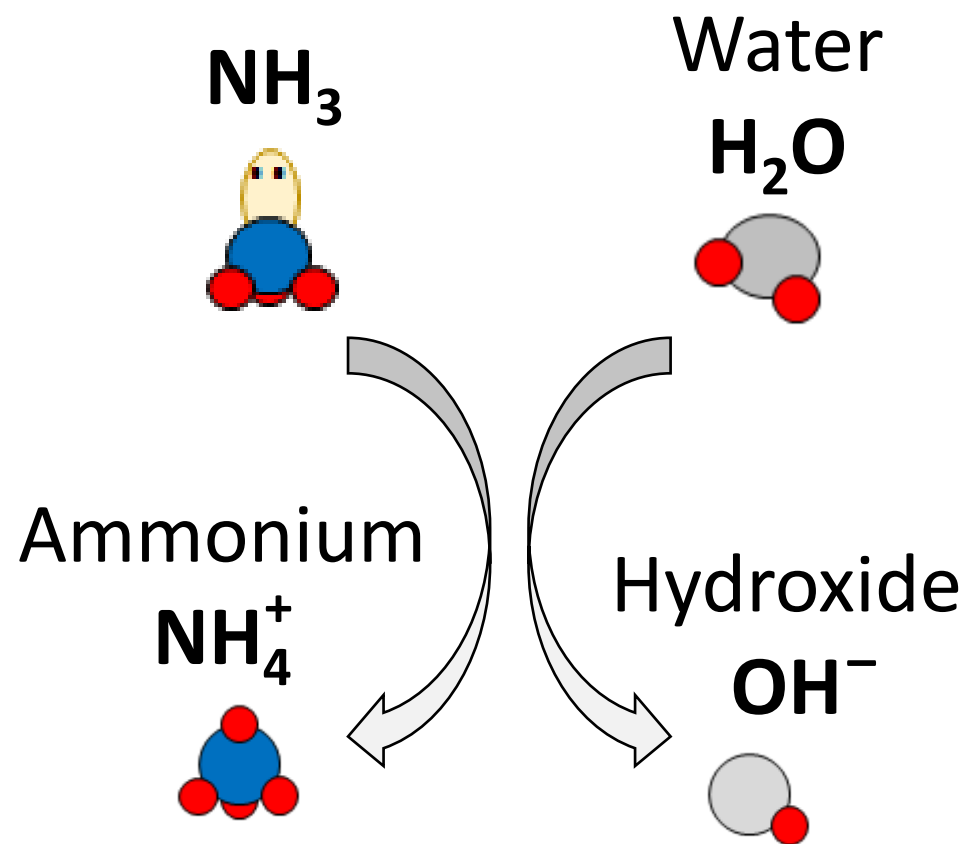
About once a week you need to clean out the excess waste with a siphon vacuum. Take out 10% of the water in and around the rocks on the bottom of the tank.

The day before you vacuum, set up clean water for the tank. Put in conditioner to get it ready. When you have finished cleaning, put the water into the tank and throw the dirty water into your garden.



Ammonia is a funny chemical. It has three hydrogens around a nitrogen, but it also has extra electrons. These extra electrons are looking for one more hydrogen. Ammonia likes to steal this hydrogen from surrounding water. This makes an ammonium and a hydroxide ion.

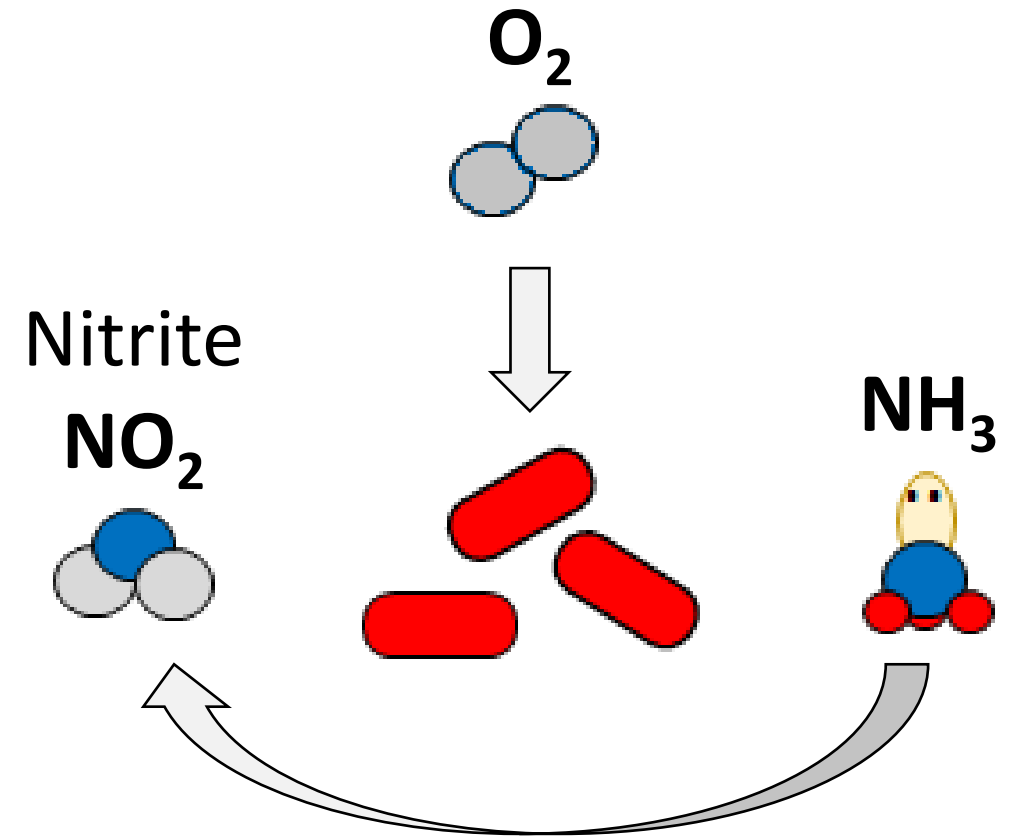
This chemistry means that Ammonia works like bleach or oven cleaner to make the water basic (i.e. too many hydroxides). Fish cannot live in basic water. It is important to get rid of the excess Ammonia before it becomes deadly.



Getting rid of the ammonia means burning it with more oxygen. This is done in two steps by different bacteria that are good at using oxygen in different ways.

Ammonia-oxidizing bacteria (AOB) have special chemicals, called enzymes, to help them change the ammonia. They use copper and these enzymes to create nitrite.

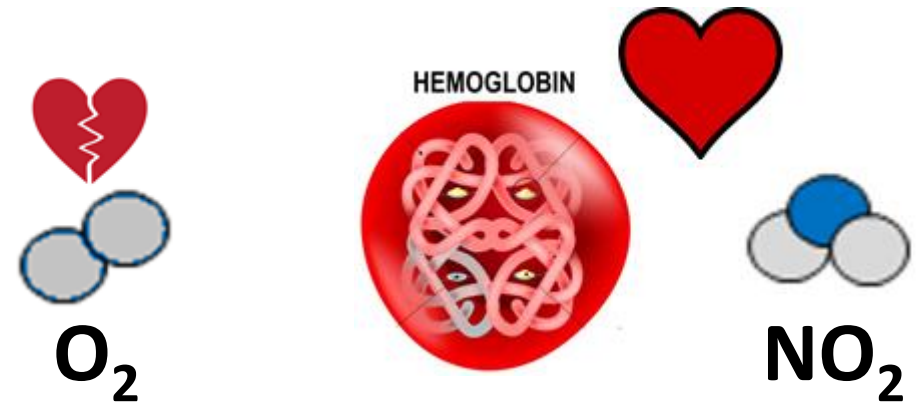
These bacteria are everywhere and most animals carry them around inside their guts. It takes a little while, but fish will supply their own (AOB).



Nitrite, however, is not a very nice chemical. We use nitrite salts to make pig meat into bacon and ham. It attacks the iron in our blood and cells.

Creatures like pigs, fish, and humans the nitrites will attack the hemoglobin in blood. That hemoglobin is what carries the oxygen we breathe. Normally oxygen and hemoglobin are friends, but hemoglobin likes nitrites more. After the nitrites bond with hemoglobin, a person can turn blue just like they were choking.

Fish can also be poisoned because they can't breathe through the nitrites.

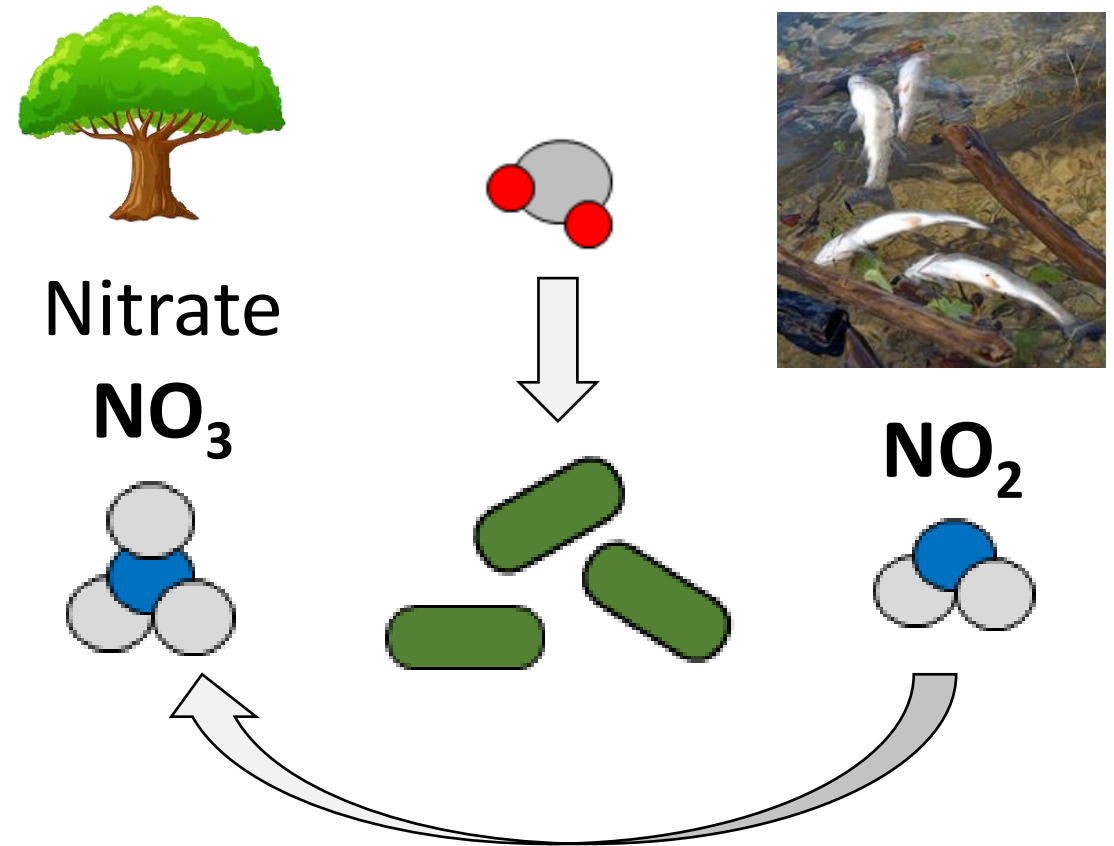




Thankfully, there are other nitrifying bacteria that love to eat nitrites. These are Nitrite-oxidizing bacteria (NOB). NOB turn the nitrites into a safer molecule: nitrate.

Nitrates are nice and stable. They combine easily to make useful chemicals. Plants especially need nitrates to make proteins and grow. Nitrates are fertilizer to the plants.

So, if you put plants in the aquarium, they will use all the excess nitrates.



All these changes are called the nitrogen cycle. All across earth there are bacteria doing different jobs to move nitrogen around.

- Dead things are decomposed to create ammonia.
- Ammonia can be turned into nitrates for plants to use.
- Bacteria also turn nitrates into loose nitrogen in the air.
- Other bacteria put loose nitrogen back into nitrates.

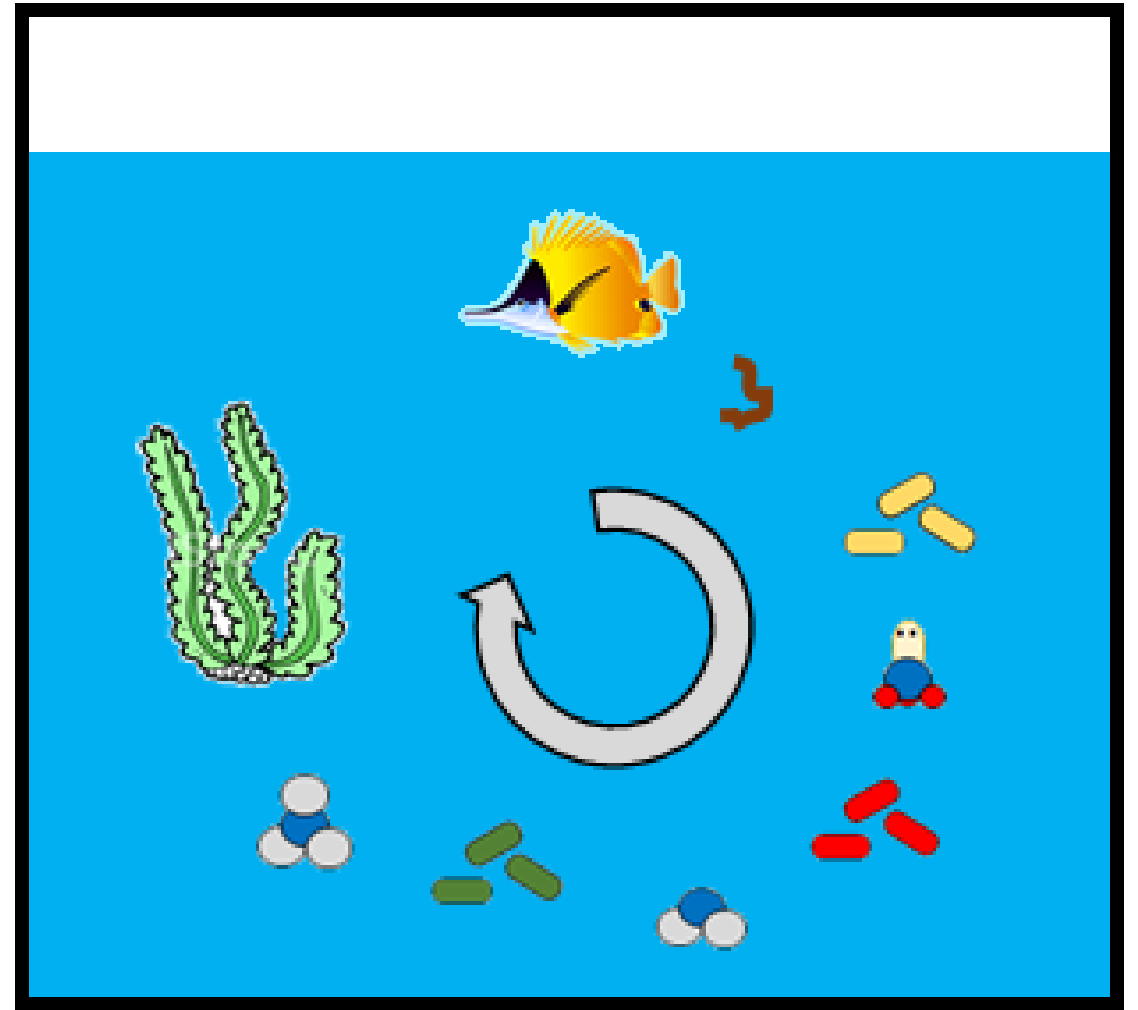
The nitrogen goes around and around.



In water, the same cycle exists.

- Fish make waste that bacteria turn into ammonia.
- AOB turn that ammonia into dangerous nitrites.
- NOB turn the nitrites into good nitrates.
- Plants can use the nitrates to grow.

Of course, an aquarium isn't big enough to deal with all the excess chemicals. People have to monitor the levels of waste chemicals and clean them out from time to time.



So, to keep your tank healthy and your fish alive remember these rules.

- Check the levels of ammonia, nitrites, and nitrates each week.
- Clean the excess dead material each week.
- Watch your fish for any signs of sickness.

Remember, happy fish swim and eat!

