

Nitrogen Cycle

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Maintaining a healthy aquarium starts with understanding the nitrogen cycle process and its effects on the overall health of your aquatic inhabitants. Sometimes called "Nature's waste management system," the process provides biological filtration in both aquatic ecosystems and in our aquariums. Because aquarium ecosystems are artificial, it's the hobbyist's responsibility to make sure the right conditions are always present for the nitrogen cycle to stay in balance.

What is the Nitrogen Cycle?

The nitrogen cycle is the process of various bacteria converting harmful waste. It involves 4 steps:

1. The first step is the decay of waste products of fish, plants, and invertebrates, along with any dead organisms or uneaten food. As these materials decay, ammonia is produced, which at even low levels will burn the gills of fish and choke off their oxygen supply.
2. Bacteria called *Nitrosomonas* consume this ammonia and, in the process creating another chemical byproduct called nitrite. Although nitrite is toxic (preventing blood from carrying oxygen), fish can withstand roughly twice the amount of nitrite in their water when compared to ammonia.
3. Next, other bacteria called *Nitrobacter* consume the nitrite and, in turn, release a less toxic chemical called nitrate.
4. Nitrate requires anaerobic conditions to turn it into harmless nitrogen gas. The parameters needed to create this condition are not commonly present in most aquariums. Hence, water changes are necessary to dilute nitrate.

The Nitrogen Cycle in New Aquariums

Because new aquariums lack the colonies of bacteria that are necessary to provide

biological filtration, the aquarium must be cycled. Cycling refers to the process of establishing and maturing the biological filter. Here's how it works:

Ammonia Spike

As the first fish in the new system begin to thrive, they produce ammonia. Without any *Nitrosomonas* colonies established to consume this toxin, levels climb and spike until the ammonia-loving bacteria population catches up. Ammonia levels then start to decline once the rate of ammonia production is less than the rate at which it is broken down by the bacteria.

Nitrite Spike

Nitrite goes through a very similar spike. Nitrite is produced through the biological activities of *Nitrosomonas* as they consume ammonia. As their numbers increase, so does the amount of nitrite, and in turn the population of nitrite-hungry *Nitrobacter* will begin booming from the abundance of nutrients. Nitrite levels will rise until the number of bacteria has increased to the point at which they break down the nitrite faster than it is being produced.

Nitrate Control

The end product of this whole process is nitrate. Nitrate, in low concentrations, is not as toxic to fish and invertebrates, but can cause other problems in the aquarium. The best way to control nitrate is through regular partial water changes.

How long does the cycle take?

Typically, new aquariums can be cycled in 2 to 6 weeks, but the actual length of time depends on many factors:

- The amount of ammonia being produced during the cycling period
- The efficiency of the biological filtration
- Whether [live rock](#) or [live plants](#) are used in this process
- Whether you boost bacteria colonies with [additives](#) and [bio media](#)

Use a quality [test kit](#) to test your water conditions every other day, and when both ammonia and nitrite levels return to zero, you'll know the cycle is established.