Cycling Protocol

"Nitrification in closed aquatic systems whether it be [20 gallons] or [20,000 gallons] in volume, is one of, if not the most critical aspects of water quality management. Nitrification is determined as the 'oxidation of ammonia to nitrite, followed by the oxidation of nitrite to nitrate, by bacteria'".

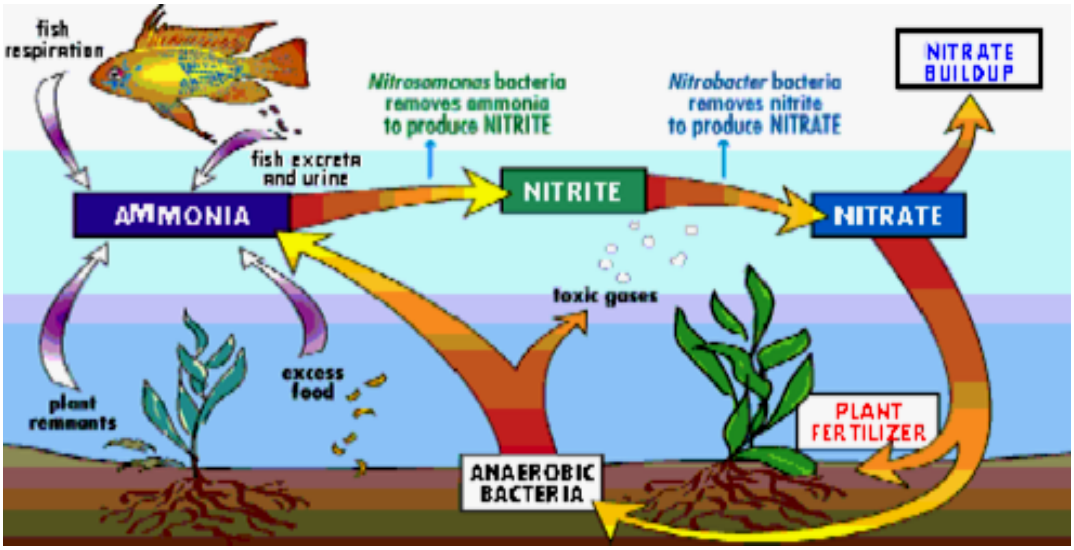
-Timothy Hovanec, Ph.D.

The Nitrogen Cycle in a Nutshell

Fish waste, excess food, plant matter, and decaying organic matter break down into a toxic chemical compound, when above a pH of 7.00, ammonia (NH_3). Even in low levels, NH_3 will increase the breathing rate of fish by irritating their gill tissues. Damage to the body tissues of both fish and invertebrates will follow, causing disease and death.

Aerobic, or oxygen needing, bacteria convert NH_3 into nitrite (NO_2). NO_2 is also a toxic chemical compound, less toxic than NH_3 yet still harmful to aquatic life. NO_2 destroys the hemoglobin in the blood of fish thus disrupting oxygen transfer between gill surfaces and the water. This too can cause disease outbreak and ultimately death.

NO_2 is converted by a second aerobic bacteria into a far less toxic chemical compound called nitrate (NO_3). Excessive NO_3 levels can cause stress, encourage disease, and could stunt animal growth. However, NO_3 can be removed by several simple means. Plants and algae naturally absorb small amounts of NO_3. The remaining NO_3 can be effectively eliminated with a good aquarium maintenance program. Regular water changes, changing of filter cartridges, vacuuming substrates, and removing detritus or debris will solve most NO_3 problems. *Note: Some home water supplies contain NO_3, thus lowering the effectiveness of a water change.



Organic vs. Inorganic
There are two ways to attack the cycling process: organically and inorganically.

Organic:
This method uses live animals, or other carbon based means, to kick-start the nitrogen cycle. This practice does work, but can be risky and dangerous to the health of the starter animal and is unpredictable with respect to chemical compound concentrations, i.e. NH_3, NO_2, and NO_3.

Inorganic:
This is the preferred, safe, and reliable method to cycle a system. It utilizes an NH_3 mimicking compound, ammonium chloride (NH_4Cl) as a substitute. This inorganic substitute allows biological processes to proceed without risking harm to animal life.

No matter how cycling occurs the beneficial, nitrifying bacteria need time to multiply to meet the biological demands of a system. The concentrating of these beneficial, nitrifying bacteria can take as much as six to eight weeks to establish. However, it can be jump-started by "seeding" the tank. Seeding is accomplished by taking a pre-existing bacterial colony from a matured system and placing it in a new system with similar parameters. The mature concentrated bacterial colony will colonize all new surfaces and substrates quicker than if the system were left alone. Thus time is minimized for the new system to establish its own beneficial bacteria colony. The graph below depicts the ideal chemical concentrations and consequently the growth of beneficial bacterial colonies with respect to time. This graph was done without tank seeding. Will your tank cycle faster, slower, or in the same amount of time? You and your class may want to compare your findings and make measurements at some predictable points during this process.