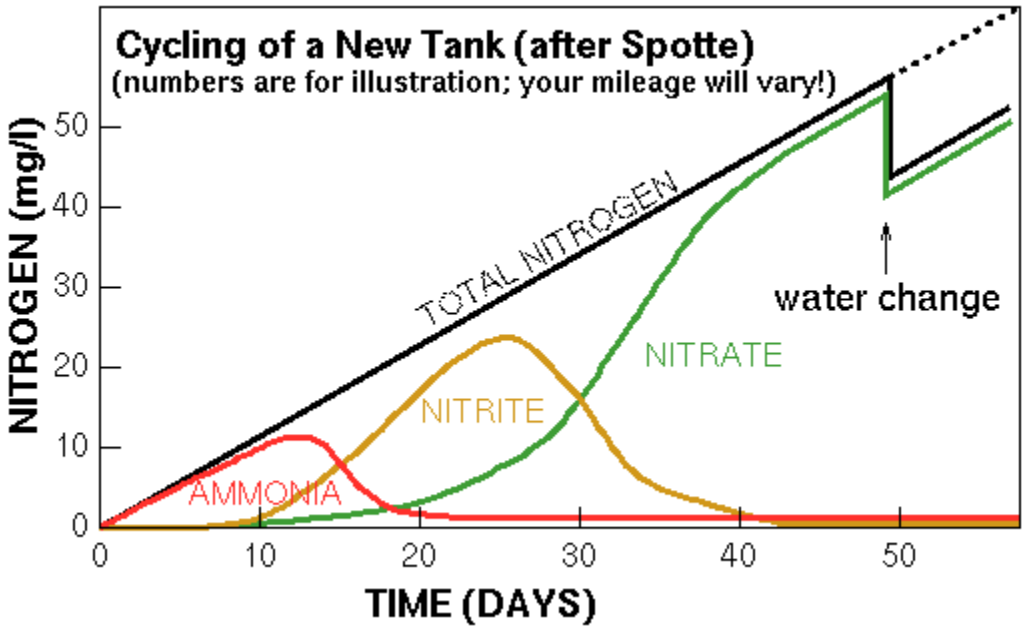
Fishless Cycling, a primer:

Background



This graph (from The Aquaria FAQ) shows a generalized aquarium cycling pattern. At first the tank contains no bacteria, and ammonia from various sources slowly builds up. This causes a boom in population of the bacteria that convert ammonia to nitrite. Ammonia levels then decline and nitrites build up, because bacteria are rapidly converting any added ammonia to nitrite. This causes a boom in the population of bacteria that convert nitrite to nitrate. Nitrates continue to build up but are reduced during water changes. Total nitrogen is constantly increasing because new nitrogen is added with food and then broken down into ammonia by fish and passed along the nitrogen cycle.

I've been reading up on fishless cycling, and I think we should take the time to do it right on these three tanks, and here's a procedure and notes I've put together from various places on the web

Day 1, Step 1:

Fill the tank with water. Add ammonia to the tanks until levels reach 5 ppm. Acceptible ranges are probably 4-6. Much more than this could inhibit bacterial growth, much less will make the process take too long. We probably want to add a couple mls at a time, wait a few minutes for it to mix, test, add a couple more, and repeat. Fortunately all the tanks are the same size, so we should soon learn how much it takes to raise the level to the appropriate amount. Make sure to document the total amount you add. Test for ammonia, nitrite, and nitrate. Also test pH. Ammonia is pretty basic, so if it raises our pH way up we will need to bring it back down. This is unlikely to be a problem though. Finally, raise tank temps up to 30-35 degrees. This will increase the growth rate of the cycling bacteria.

Step 2:

Measure ammonia levels and nitrite levels daily for the next few days. Each day add the same amount of ammonia that you added the first day. Do this every day until nitrite appears and starts increasing. We should measure first and then add the chemicals, so we will be looking at the levels after 24 hours of filtration, not the levels of chemical that we just added

Step 3:

Now that nitrite is present, test the water and add half the original level of ammonia daily. Ammonia levels should continue to decrease and nitrite levels should increase, then decrease. Nitrates should slowly increase.

Step 4:

At some point we should have nothing but nitrates present in visible quantities. This is when we can add the fish. So we drop the heater down to some reasonable temperature, change about 90% of the water (to reduce the now sky high nitrate levels) and add new water and the fish.

IMPORTANT NOTES

Partially Cycled Tanks: Some of the blue tanks we have set up already may be partially cycled already. This shouldn't have much effect on the procedure, other than speeding up the process.

Water Changes: Note that you don't do any water changes during the cycling process, just a big one at the end. Water changes would reduce the amount of ammonia and whatnot available to bacteria to increase their populations.

Water conditioner: We need to be aware of some possible issues with our water conditioner. We have (I'm pretty sure) amquel conditioner. Amquel binds up ammonia in the water, and adding it to the water during the final water change in step four can cause all ammonia to be bound up for a while. This could cause a crash in the ammonia-consuming bacteria colony by starving it, effectively partially de-cycling the tank. Some people seem to have had this problem, but I don't know how wide spread it is. We do want to use dechlorinator of some sort (and add it before or as we are adding the water, not after we've filled it from the hose) so we don't zap the bacterial colony with chlorine.

Amquel may (or may not) also be falsely giving us positive ammonia readings on our test kits. We should check this.

Cycle bacteria: Opinion seems to be split about whether or not those cycle bacteria solutions do any good. Everyone says they are unlikely to do any harm. If we ever get rid of the problem of disease and thus don't have to worry about cross contamination, we might want to also use gravel and filter materials from old, cycled tanks to help seed new ones, since these contain a bacterial mix specifically adapted to our tank conditions. Another approach is to run an extra filter on a previously set up tank for a while before setting up a new tank, then swap that filter, pre cycled, over to the new tank.

Ammonia Sources: We're a science lab, we ougtta be able to get the real thing. However, if we don't have any lying around, the best to use is the plain, cheap kind from the hardware store. You need to absolutely avoid any with soap, perfumes, surfactants, or any kind of additive. Also note that the hardware store stuff (at 4-10%)is more dilute than lab grade, so we would need to add a smaller amount of lab grade ammonia to get the desired concentration. Household grade might be added at about 1 cup per 100 gallons

Maintenance of cycle:

One handy thing about having ammonia around is that you can keep tanks with no fish in them cycled. Tanks with no fish rapidly lose their bacterial populations and become uncycled. By adding small amounts of ammonia every day (we'll have to figure out an appropriate amount) we can keep tanks cycled between experiments if necessary.

Food

Yes, in theory we could do this whole thing by just feeding the aquariums. But using the chemical gives a bit more control and allows you to run the process a bit faster (because you don't have to wait for the food to rot)

Things Cycling bacteria like

The bacteria are aerobic, so they need 02. The surface areas of our tanks should be enough, but we could always aerate for increased efficiency. They like ammonia, but not extremely high levels. They don't like really low pH levels. They compete with heterotrophic bacteria (the ones that break down uneaten food) for space and o2. They grow faster at high temps.

CITATIONS

Here's where I got most of my info from

http://malawicichlids.com/mw01017.htm

http://www.skepticalaquarist.com/docs/startover/fishless.shtml

http://www.csupomona.edu/~jskoga/Aquariums/Ammonia.html

http://www.aquahobby.com/articles/e_fishless.php