



Maintenance for FoodChain's 10 Gallon Aquaponic System

About Aquaponics & Your System

Aquaponics is a way of growing both fish and plants symbiotically. As the fish are fed, they naturally produce waste, which over time can become toxic to them. However, this waste is very rich in nitrogen, in the form of ammonia, and plants need nitrogen to grow. The nitrogen in the ammonia is made available to the plants through naturally occurring nitrifying bacteria (the good kind!) that turn the ammonia into nitrate, which works as excellent plant food. Therefore, in an aquaponics system, the fish waste is used as free fertilizer for plants, who then absorb the nitrogen from the water and thus cleans the water that then goes back to the fish.

Your system is a small representation of what is called *deep water aquaponics*. There is also nutrient film technology and media-based aquaponics. Deep water aquaponics simply means that the plants are *floating* on more than a couple inches of nutrient-rich water. This allows the roots of the plants to have access to all the water and nutrients they need. You do need to provide the roots with oxygen, which we have done via the air stone in the growbed. In your system, the beneficial bacteria colonize on practically every submerged surface of your system. We've added plastic dish scrubbies to the fish tank that allow large populations of the bacteria to colonize due to the high surface area (all those nooks and crannies) of the scrubbies.

The fluorescent lights used for this small aquaponic system are set on an 18 hour timer. This is the amount of time plants need for vegetative growth. However, for fruiting or flowering plants you will need to cut the lighting down to about 12 hours a day. For such a small system we recommend only using vegetative plants since fruiting and flowering stages of plant growth may require additional nutrients that may not be provided by the fish. We do encourage experimentation though!!

Early Stages

After cycling water through your system for a couple of weeks to bleed out any chlorine, which is toxic to fish, your system is still not quite fully established. Nitrifying bacteria populations have not yet colonized and therefore ammonia is not yet being converted to nitrate. For this to happen the system will need to go through a process called *nutrient cycling*. First, fish will be added to start producing ammonia, their natural waste product. After about a week the first round of bacteria will appear and begin converting ammonia to *nitrite*. This is very vulnerable time for the fish. The fish will have to deal with higher levels of ammonia and will need to be fed as sparingly as possible. Too much feed will cause them to produce too much ammonia resulting in sickness and potentially death. After nitrite is present, another round of naturally occurring bacteria will begin populate the system and convert nitrite to *nitrate*. It will be at this point that the system is fully established. Typically the entire process takes 2-3 weeks.

These early stages will allow you to get comfortable with your water testing kit. Every day you'll need to test the pH, along with the levels of ammonia, nitrite and nitrate. (Upon the addition of fish to your system you can start your plant seedlings in a separate location. By the time nutrient cycling is completed, you should have transplantable seedlings to add to the system.)

pH: You just want to ensure that your water pH doesn't change radically. Ideally, the system will hold around 6.8, but an established system could drop in pH. In this first stage of operations, you'll likely hold fairly steady. If you do notice considerable drops in pH, please refer to the Troubleshooting section of this handout.

Ammonia: Once fish are added, you'll begin to see rising levels of ammonia. Again, ammonia is toxic to fish, so if it rises too high, you want to cut back on feed as much as possible. This won't hurt the fish, but rather they'll simply slow down their metabolism. This most likely will not be an issue for you since the stocking density of the fish is so low.

Nitrite: This is the first sign that your bacteria are colonizing. After about a week from when fish are added, the first wave of bacteria will begin to convert the ammonia to nitrite. Once you see this show up, you should notice a corresponding drop in ammonia. You're well on your way now!

Nitrate: This is plant food and also the final product from the bacteria. After about another week or so, the second wave of bacteria converts the nitrite to nitrate. Therefore, as you see the nitrate levels appear, you should see diminishing nitrite levels. By this point the ammonia levels should be close to zero. After a few more days, the nitrite levels will also drop to near zero and all the fish waste will be available as nitrate for your plants.

Once your water tests show low to no ammonia and nitrite but measurable levels of nitrate, you've got a fully cycled system! You can now feed your fish more aggressively! Also, you can begin transplanting into the rafts of your system. When transplanting you will want to gently rinse the roots of the seedlings with room temperature water before adding them to the net cups.

Maintenance and Troubleshooting

Maintaining your aquaponics system is a relatively simple process, it just needs a watchful eye.

1. **Fish:** You'll want to feed your fish each day. For goldfish you want to feed as much as they can consume in 5 minutes per day. We suggest feeding 2-3 times a day which would equate to as much as they can eat is 1-2 minutes per feeding.
2. **Plants:** Keep an eye on the plants to make sure they're growing healthily. Healthy plants will have vividly green leaves and show considerable growth over a few days span. Herbs grown in this system will grow continuously towards the light source. You can trim herbs at any stage past seedling. However, we recommend trimming when the plants get close to the light so they don't burn or if/when they appear "leggy." When trimmed, leggy plants will grow back more fully.
3. **Water Quality:** Continue to monitor your pH, ammonia and nitrate levels daily. Ammonia should stay close to zero and nitrates can rise to as much as 100ppm, though between 30-60ppm is better. The pH should hover around 6.8 and within the range of 6.5 – 7.2.
4. **Solids:** If you begin to see solids accumulate in the bottom of the aquarium and/or growbed, you will need to clean them out. Most likely you can just use the fish net to scoop the solids up. Periodically you will also want to clean the water pump and scrubbies from any solid accumulation. To clean the pump simply unplug it, slide off the cover, and clean with warm soapy water. Make sure all soap residue is rinsed completely before adding the pump or scrubbies back to the system. When these solids are left unattended, over time they will break down and increase ammonia levels of your water, potentially harming the fish.
5. **Weekends, Vacations & Holidays:** You will want to keep everything plugged in and running when not in the classroom. The plants should be fine during any extended breaks. The fish however, might require some attention. Most fish, including goldfish, can go a week or so without eating and be completely fine. If you will be away for more than a week we suggest having someone come in to feed them or purchasing an automatic fish feeder.

Still have questions? Here are some common questions and tips.

About the Fish

1. *My fish seem to be “gasping” a lot at the top of the tank, is this normal?*

Yes and No. Fish that come up for air and “gasp” at the top of the tank do so because the water does not contain a sufficient amount of oxygen for them to be comfortable. You can find this out by using a Dissolved Oxygen (DO) meter; you want a reading of at least 4 mg/L. This however is most likely due to your air pump, so you should check to make sure that it is working properly and bubbles are rising from the air stones.

2. *My fish keep dying, but I’m feeding them regularly, what’s going on?*

With this, any number of things could be happening. The most likely situation is that the ammonia that the fish are producing is not being cycled properly into the rest of the system and is polluting the aquarium. Check the water quality and if there is too much ammonia in the water, you can lessen the strain on the fish by simply replacing some of the water with new dechlorinated water. However, this issue is probably caused by either a blockage in the system, or with the bacteria dying off. If the bacteria are dying a short term solution is to slow the frequency in which you feed the fish (don’t worry they won’t die, but they will stop producing ammonia which should allow your bacteria time to catch up). When the levels drop again to zero or close to you can resume feeding but just do less.

About the Plants

1. *How long can I expect until I see my plants start growing?*

Every plant is different, and will grow at different rates. For example, herbs will grow much quicker than a tomato plant. However, when you are working from seedlings, it will generally take about two weeks for a plant to get fully acclimated to a system and to start growing new sprouts. Don’t despair though, as with all manner of growing, patience is key.

2. *I’m getting a lot of yellowing leaves from my plants, is this normal?*

Yellowing leaves simply mean that the plant is not healthy, and could be caused by any number of things. Check the water quality to first make sure you have enough nitrate (plant food). If your system has been running for a while, you may be running low on iron. In our system, when needed, we supplement our plants by adding some chelated iron (we recommend Grow More Organic Iron Chelate Concentrate, available on Amazon). Look online for more details on this procedure and amounts.

3. *I'm noticing some insects in my system, what do I do with them?*

The most important thing to note here is not to use any form of insecticide. The ingredients in insecticides will immediately kill all the bacteria in the system, which will severely cripple it, as well as your fish. The best thing to do is to either physically remove the bugs, or to place sticky yellow traps around the edges of the system. You can prevent insects by removing sick or dead leaves and plants from the tank, and cleaning out any accumulated dead plant material.

About the System Water

1. *How frequently do I need to do water quality testing?*

Ideally every day. This will ensure nothing happens suddenly. With only 10 gallons of water in your system, things can change quickly!

2. *There seems to be some sort of solid accumulating at the bottom of my fish tank, is this normal?*

Yes, it's normal, but it's not ideal. The solids can get stirred up in the water and eventually hurt the fish as they break down into ammonia. As with any aquarium you will need to clean the solids out periodically.

3. *According to my meters, my pH levels are getting really low, what can I do to fix them?*

First this is a good thing and means your bacteria are healthy! The best and most efficient way to push your pH level back up is to add small amounts of diluted Calcium Hydroxide (available at most hardware stores as a garden amendment) directly into the fish tank so that it may be slowly funneled through to the rest of the system. Another product that may help is called "General Hydroponics pH Up" and is sold in most pet and garden stores. (Hydroponic stores will definitely carry this product.) You must be careful when adding any other chemicals to your system. Those specified for plant use may have adverse effects for the fish and vice versa.

4. *I've recently had a huge spike in ammonia, what's going on?*

A big spike in ammonia could result in the fish fatalities so you want to take it seriously. You may already have a dead fish in the system, which is breaking down already. (Note: not all fish float when they die, some sink.) Our recommendation is to slow feeding the fish as much as possible. Also, check to make sure you don't have large amounts of solids in the bottom of the fish tank. If that doesn't work and the ammonia is still high after a few days you may need to resort to a water exchange with chlorine free water. This should be a last resort though.

5. *My power has gone out, what do I do?*

The plants can go some time without receiving light, but the most important electrical aspect of the system is the Air Pump. Without it the fish can get some oxygen from the outflow agitating the water. However, over time the fish may not receive enough oxygen and could die. When the

fish do not have enough oxygen in the water, they will begin to gasp at the surface. If the power is out for a considerable amount of time you may want to consider providing electricity to the air pump from a generator.

Other

If you do not see your question on this list, there are obviously a lot of other resources for assistance. The internet has hundreds of pages for reference and many forums. Also, you can contact FoodChain with any questions or concerns at (859) 428-8380.