



FOOD FOR FREEDOM



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Introduction

You may have noticed things around the world seem to be on very shaky ground. Our economic future is unsteady and with an uptick in severe weather, our food supply systems are being greatly impacted. No matter how much food is in the grocery stores today, people are beginning to realize the food supply is not a guarantee. There may be a day when food is no longer on the shelves.

It could be the result of some horrible natural disaster, an act of war or an economic collapse. It is impossible to determine exactly what will be the undoing, but people from all around the world recognize the edge of the cliff we are all standing on. One little push will send us careening into a world where food is not a guarantee.

In order to prepare for that eventuality, many people are looking into supplying their own food. They want to be self-reliant. If the grocery stores are empty, that will be okay, because they will have their own food source tucked away safely at home. That food source will be survival aquaponics.

While the rest of the city or country is foraging in the woods, scavenging or looting what is left, the prepared person will have a steady supply of food that will continue to thrive and be replenished.

For those who still assume a food shortage could never happen, look at what happened in 2005 in Niger and in 2010 in Sahel. Most recently, Venezuela has fallen victim to a major food shortage that has left citizens literally starving.

Preppers and survivalists have been preparing for a food shortage with stockpiles of food, which will certainly help, but it is also a good idea to have renewable food source as well. This book will teach you everything you need to know about survival aquaponics right down to how to build your very own system at home.

Why Go with Survival Aquaponics?

If you are wondering why you should be interested in survival aquaponics, there are actually several good reasons. The main goal of aquaponics is to give you a fresh food source. When you think about the aftermath of a major economic collapse, food shortage, serious natural disaster or even civil unrest that makes it dangerous to leave your house, you will understand why it is important to have a source of fresh food available.

If you already have a nice stockpile of food that includes cans and freeze-dried foods, you may be thinking you don't need aquaponics. You do. Aquaponics gives you something the freeze-dried and canned foods are going to be lacking—nutrition. You will get more nutrition from the fresh food you get from your aquaponics system than you could from your food stockpile.

It will also be a nice change up and much healthier for you to have fresh food in your daily diet. Humans need a variety of nutrients and minerals that can only be found in fresh green vegetables. You can't get them from preserved food. Think of these things as phytonutrients. Having fresh greens to add to your daily diet of freeze-dried and canned food will help you get a good daily dose of antioxidants that will help keep you healthy.

Another reason people are choosing to go with survival aquaponics is because of the cost of food in today's world. It is only going to get harder to put fresh food on the table as food prices continue to increase. We have already seen things like the cost of fuel increasing, which directly increases the cost of food. Inflation and a lack of water are also known to increase food prices. Poor government can also be blamed for food cost increases and that seems to be happening more frequently every single year.

In fact, if you look at the countries and regions that have the most unstable and corrupt governments, you will also find those are the places where there are food shortages and inflation that makes the price of basic food staples extremely difficult to buy. The people who live in these areas can do very little to help themselves other than growing their own food.

For many preppers and survivalists, it is easy to get hung up on the act of survival. Everything else is ignored in favor of surviving. However, survival isn't going to be worth it if you are miserable. Living through a disaster or major event that leaves a deep scar on the world is great, but you also need to rebuild and start fresh so you can have a happy life.

Having good, healthy and nutritious food available is definitely worth looking into. Imagine being able to eat fresh produce that is crisp, juicy and sweet rather than the canned mush. Good morale is important after a devastating event and good tasting food can have a direct, positive impact on morale. It will help satisfy the body's cravings, which are basically a demand for certain nutrients that you are lacking. Being able to eat food that you enjoyed prior to your life being turned upside down will help you maintain a sense of normalcy and give you the strength to push through.

Have you ever walked into a lush garden or an indoor garden filled with lots of healthy, green plants and noticed you just want to breathe deep? You want to spend some time looking around and just enjoy the vegetation. Plants have a funny way of lifting our spirits. After a collapse, when the world looks destitute, having a place to go that is filled with healthy thriving plants will uplift your spirits. It buoys you and will give you hope.

Fresh food isn't just a luxury, it is a requirement for good health. Our bodies were designed to use the nutrition in fresh fruits and vegetables to keep us energized and our muscles and bones in good condition. Our organs need the nutrition to function properly. You cannot expect to live long after a disaster if you don't have access to fresh food.

What is Aquaponics?

Before we get much further, let's talk about what aquaponics really is. It isn't really anything new. People have been raising fish in ponds and barrels for a

long time. Aquaponics combines aquaculture with hydroponics. Hydroponics is the growing of plants without any soil.

Unfortunately, growing fish in ponds or barrels is very labor intensive and can actually be toxic to the fish in the water and the environment when the water is dumped or cleaned. As fish eat and live, they are producing a lot of waste nutrients from all of the food that is dumped into the water. Some of these aquaculture systems have been blamed for polluting areas and the practice itself is quickly losing favor.

Now, hydroponics has been around for some time. It is a great way to grow food without having a large garden plot. Tomatoes, cucumbers and lettuce are very popular crops grown in a hydroponics system. They thrive and can be quite prolific. The downside to the hydroponics system is the waste of nutrients that are produced by the plants that are going nowhere. It can also get expensive to buy the necessary fertilizer to feed the plants due to the lack of soil.

Aquaponics is the marriage of the two agriculture systems that creates a healthy, beneficial balance between the two. The plants will use the nutrients the fish waste produces, which is basically free, natural fertilizer. The fish will thrive and use the nutrients the plants' roots put into the water. When the roots of the plant absorb the fish waste, they are essentially cleaning the water. This makes it a win-win situation for the plants and fish and of course, you!

As you feed your fish, you will be feeding your plants. As the plant's roots hang into the tank, they are going to start a process known as mineralization. The fish waste contains valuable elements the plants need to thrive;

- Nitrogen
- Phosphorus
- Potassium

Organic gardening is a hot topic these days and when you use an aquaponics system, you are getting an organic process. Nature is taking care of the feeding of the plants and the plants are creating a healthy environment for the fish to live in.

Without the roots filtering the water, there could be a very dangerous build up of ammonia in the water. This will kill the fish, which is why aquaculture can be very problematic. You have to have an excellent filtering system in place and you have to work hard to achieve a fine balance in the tank to prevent ammonia build up.

The plants are removing the proteins in the fish feces and creating ammonia. As the ammonia is created, the roots add oxygen, which gives you nitrate. This process is referred to as nitrification and is one of the most important elements of your aquaponics systems.

Mineralization and nitrification require the use of oxygen, which means oxygen is one of the most important keys to your aquaponics system really working.

You will need to pay close attention to the oxygen levels in your tank. All living creatures, including the plants, need oxygen. If there is a lack of oxygen available, your fish and plants will suffer.

If there is a lack of oxygen, nitrification will not happen as it should. If this happens, ammonia will build up and the water will become toxic to the fish and the plants. You need to really monitor the levels in your tank.

Fish feces is high in;

- Iron
- Calcium
- Potassium
- Magnesium

These are all compounds your plants need to thrive. Fortunately, if your tank is off a little, you can adjust levels by purchasing additives to make up for a lack of any of these compounds.

In this book, we are going to stick with the easiest aquaponics system referred to as a media-bed system. It is perfect for the home aquaponics set up and fairly easy to set up. It is the perfect solution for the beginner.

Aquaponics vs. Survival Aquaponics

In the beginning of the book, you were promised a book about survival aquaponics. You may be wondering what the difference is between aquaponics and survival aquaponics. The short answer is there is really very little difference. The main difference between the two is the main goal of the system. Survival aquaponics are set up with the intention of providing fresh food in a survival situation when things have gone bad and you can't run to the store to get what you need for your aquaponics system.

Things like;

- Electricity needed for the system
- Feed storage
- Simplicity of the system design
- Availability of parts

These are going to be a big deal. You need your system to still be functioning even if the power grid is down.

A survival aquaponics system is being established as a main source of food, while an aquaponics system may be more of a supplemental food source. When you are putting together the survival aquaponics system, you want to do it with extreme situations in mind, like a lack of reliable power.

If you plan to use solar power to keep the system functioning, you need to plan for that now.

Food is essential for your fish to live. You need to figure out where you will store the fish food and how much you can store. Plan some space in your home for fish food storage. Without feed, your fish will die and your system will fail.

The setup needs to be very basic. You are not going to have access to the internet to order hard-to-find parts that are specially made for an aquaponics system. It needs to be very basic so you can repair it easily. You also want to make sure you have fail safes in place. It is often referred to as a redundant design so you don't have a single point source failure.

That means, you don't want one little issue to take down your entire system. It needs to have backups for the backups.

Lastly, the availability of the parts you use needs to be heavily considered. Use inexpensive parts that are easy to find or put together with things you can find around the house. You will need to think out of the box sometimes. Having a nice supply of spare parts is going to be a very helpful resource should you need to make any repairs.

Depending on where you plan on holing up after a disaster, you will need to think about how much space your system will take up. If you are in a small cabin, you need to plan on maximizing the space to get the most out of your system. One way to maximize space is take advantage of vertical gardening.

Using walls to set up your system is an efficient way to use space.

Survival aquaponics are supposed to feed your family, which means you need to get quite a bit of food from the systems. You need to design a system that gives you the biggest bang for your buck. This is one aspect that will take some trial and error. An aquaponics system needs to have something growing at all times. Unlike a traditional garden where you tend to do one harvest and the plants die off, you want new food constantly being produced.

Keeping a supply of new, young fish in the tank is going to be the key to your system functioning for the long term. You want to have a variety of older, middle-aged and young fish constantly in the tank. If the fish die, you won't have anywhere to run out and buy new fish after a major collapse.

Earlier we mentioned an aquaponics system could be used as a backup source of water. This is true. Your aquaponics system is going to lose very little water on a daily basis, maybe 1 to 2 percent. A system that is nice, healthy and has a good balance of nutrients and minerals can technically be drunk without filtering or purifying. However, if you cannot guarantee the quality and levels of the water in your tank, you will want to purify it just to be on the safe side.

If your aquaponics setup is outside, your main issue will be poop and debris falling into the water and throwing off the nutrient levels. You will need to make some kind of cover to keep out debris and to prevent animals from fishing in your tank.

The plants you grow in your system are going to be excellent water purifiers. You won't need to invest in expensive equipment to clean the water or remove the nitrogen. Let nature take its course and enjoy the fruits—literally, of your labor.

Traditional Gardening vs. Survival Aquaponics

Some people need to see why they should invest time and money into learning a new way to grow food, especially those experienced gardeners who have mastered the art. There are several very good reasons aquaponics is better than traditional gardening methods.

Less Strenuous

Toiling in the soil can be very labor intensive. You will either be on your knees or bending over a great deal, which can be very strenuous. You don't have to worry about tilling the soil or pulling weeds with an aquaponics system. Aquaponics systems do require some work, but they are set up to be about waist high. You won't be bending over or spending hours under a hot sun tending the garden.

Year-Round

One of the major benefits to an aquaponics system is the fact your garden is not limited to the seasons. You can grow fresh food all year round no matter if it is the dead of winter.

Environmentally Friendly

Gardens can be a burden on the environment due to the amount of water needed to help them grow and in some cases, the fertilizers that are put into the soil. Aquaponics is designed to maximize the nutrients in the water, which eliminates the need for fertilizers. You won't have to worry about plants wilting because the nutrients you added to the soil were absorbed by weeds, blown away or watered down.

You will also find you get a lot more produce from less space. The plants tend to be healthier because of the close monitoring of the water condition. You get to choose just what plants get what nutrition and how much. You don't have to worry about the weeds creeping and stealing the nutrients.

Efficient

With water shortages a growing concern, you will be happy to know aquaponics actually uses about a tenth of the water of a traditional garden. The water is constantly being recycled. You can also see your aquaponics system as a place to store water.

Preppers like to have large barrels of water on standby, but they do nothing more than take up space. Now, you can use your stored water to grow a garden.

Flexibility

You can set up your aquaponics system nearly anywhere. You can have it in your basement, your rooftop, garage, a spare bedroom or outside on the patio. There are going to be special considerations for each space, but you are not limited to a garden plot. For those who don't have a yard, aquaponics is an excellent way to grow food without worrying about the lack of a backyard.

Aquaponics are absolutely worth it, but they can be a bit labor intensive to get started up. Once you get the hang of it, it will be a breeze.

Ensuring the Safety of Your Aquaponics System

You will want to think and plan for the safety of your aquaponics system. You don't want anyone getting hurt.

Some of the biggest concerns you will need to plan safety measures for are listed below.

- Accidental drowning is a possibility if you have young children. They may be intrigued by the water and fall into the tank. Either put up a fence or close the tanks off so kids can not get to it.
- Electrocutation is a possibility because you will be using submersible pumps. Make sure you are using the right equipment designed for underwater submersion. Make sure the cords are in good shape as well.
- Back strains can be an issue if you are lifting heavy bags of gravel. You will need gravel or another media for your system. Either use a hand truck or always remember to lift with your legs, rather than your back.
- Toxic contamination is an issue if you have purchased tanks that have been used to hold toxic chemicals. Only buy tanks that you know were used for food-grade materials that will not cause problems for your fish or the ecosystem. Most of these tanks are labeled as food-grade. Avoid getting used tanks from manufacturing companies or auto repair shops.
- Tanks falling over or breaking altogether can be an issue. You will want to make sure you secure the tanks and ensure they are in good shape.

What You Need

It is time to start talking hardware and what you will need to build your survival aquaponics system. Before we get too far into what you need, you need to know there are actual kits available that include everything you need to set up an aquaponics system.

These are perfect for the person who doesn't have a lot of technical skill or doesn't have the time to really get into building a system. You can expect to pay quite a bit more for a kit than you would if you were going the do-it-yourself route. It is your choice.

If you are building your system for a unique space in your house or you want to set the system up to run off solar power, you are better off building it yourself. This allows you to customize it to your needs.

Tanks

One of the most important components of your system will be the tanks. You can use barrels or IBC (international bulk containers) tanks, which are made from a plastic material that is easily cut and melted to create your system. They are fairly inexpensive and can be bought in a number of different places all around the world.

In some places, you can expect to pay anywhere \$20 to \$100 for a used tank. Check yard sales and second hand stores as well.



Barrels

If you are not sure about the history of a tank you are looking at, it is best to pass. You don't want to ruin your system by buying a toxic tank. If you know what was stored in the tank, but are not sure what it is, do some research to see if it can be washed away with soap and water. You will also want to check to see if it is harmful to fish.

Old Bathtubs

If you can't get your hands on food-grade barrels, old bathtubs are an option. These are often given away or sold at a very low cost. You can check dumps or put an ad in the paper that you will pick up old bathtubs.

Swimming Pools

If you have an old swimming pool that you are really never going to use, you could convert it into an aquaponics system. It is a pretty big endeavor and is only really worth it if you have no interest in using the pool. You could also invest in a small kiddie pool for your system.

Building Your Own

If you want a bigger system, you can build a tank out of wood. Frame the tank with 2x4s and then add OSB boards around the frame to create a box. You will need to invest in a heavy-duty liner to line the system to keep the wood from getting wet. This is a very inexpensive way to get a good size system.



OSO Vs. Plywood

Plumbing Components

Plumbing is probably the second most important part of your system. You will need a variety of plumbing parts to build the system. They are as follows;

- Pumps (you can take advantage of gravity for some of the system needs)
- Valves
- Pipes
- Joints

You will need pumps to circulate the water from one tank to another.

You can buy these online for very little money. The key is to get pumps that will work with whatever power source you plan to use. That may be DC, AC or solar.

Media

Media is the term used to describe what your plants will sit in instead of soil. There are several options here. One of the least expensive options is gravel or granite. You can buy truck loads of gravel for as little as \$20 bucks in some areas. That will be far more gravel than you could ever use. You can also buy gravel at fish stores.



Granite



Gravel

Another option that is very nice, but tends to be a bit more expensive is something known as hydroton. Gravel is cheaper, but it isn't quite as easy to work with as the more expensive option. However, you can make it work.

When you are looking for the right media, you want one that doesn't have a lot of carbonates, but provides plenty of surface area for your microbes to live and thrive in.

To test a media for carbonate, fill a small bowl with vinegar. Drop a few pieces of rock into the bowl and watch the reaction. If there are a lot of bubbles, there is too much carbonate and you don't want to use it in your aquaponics system. A high concentration of carbonates makes it tough for you to regulate the pH in your tank, which can cause all kinds of problems.

Choosing the Fish for Your System

Fish are an intricate part of your survival aquaponics system. You want to choose fish that are going to be hardy and not overly sensitive to minor problems with the water pH.

Freshwater fish are the easiest to get and care for. Choosing fish that are okay with slightly murky, muddy water and objects floating in the water is going to be your best bet.

Catfish

Channel catfish are easy to get your hands on and very easy to take care of. They will feed off the bottom of the tank and will need to eat high protein food like fresh bugs or a special food. The best place to find the channel catfish is at a local hatchery.



Channel Catfish

Tilapia

Tilapia are some of the most common types of fish. There are three main types of tilapia; Nile, White and Blue. Because there has been so much breeding between the different kinds of tilapia, you are probably not going to find a purebred line, which is okay. Tilapia are often a number one choice because they are omnivorous and don't require a high-protein diet—insects and what not. You can feed them vegetable produce, which you will be growing in your tanks. You can feed them bugs and grass clippings, which makes them easy to feed in a post-disaster situation.

The mild-mannered fish will get along well together in the tank, which has made them the favorite among aquaponics users all over the world.

The tilapia are very forgiving and will do okay, even if the water gets a little cloudy and murky. However, there are some places it is illegal to have tilapia. You will want to check with your local laws.

You can buy tilapia from a hatchery or another hobbyist.



Red Tilapia

Miscellaneous Fish

There are a few other choices you have when it comes to stocking your tanks with fish.

- Carp are an option and won't mind less-than-perfect water quality. Some areas do not allow you to have carp in your systems. Check to be sure before you buy.



Common Carp

- Yellow Perch are often used, but not recommended. They are much more difficult to maintain and will not be as easy to keep.
- Rainbow trout are a favorite fish in general and people are using them in their tanks. However, the fish need cool, clean water with lots of live feed. If you live in a cold climate and can keep the water nice and chilly, this may work for you. If you don't have loads of live feed, you will need to store high-protein food to keep the trout happy and healthy.
- Goldfish, like Koi, are a common option. These are more for decorative purposes and you probably wouldn't want to eat the fish. Goldfish are low-maintenance and won't die with water that isn't just perfect.



Choosing Fish Based on Climate

We just mentioned trout and how they require cold water, which means a cold climate.

You need to choose fish that will thrive in your climate. If you live down South where it tends to be warm, trout are not a good choice for your tanks.

A good warm water fish is tilapia. They will like the warm water and do just fine. You wouldn't want tilapia in an area where it is cold. Cold temperature fish like goldfish, Koi and trout are perfect for northern climates.

Caring for Your Fish

Before you pick the fish you will have in the tank, you need to have a very good idea about what kind of tank system you will have. Each type of fish will have different requirements and you need to make sure the system you will be setting up will create the best environment for the fish.

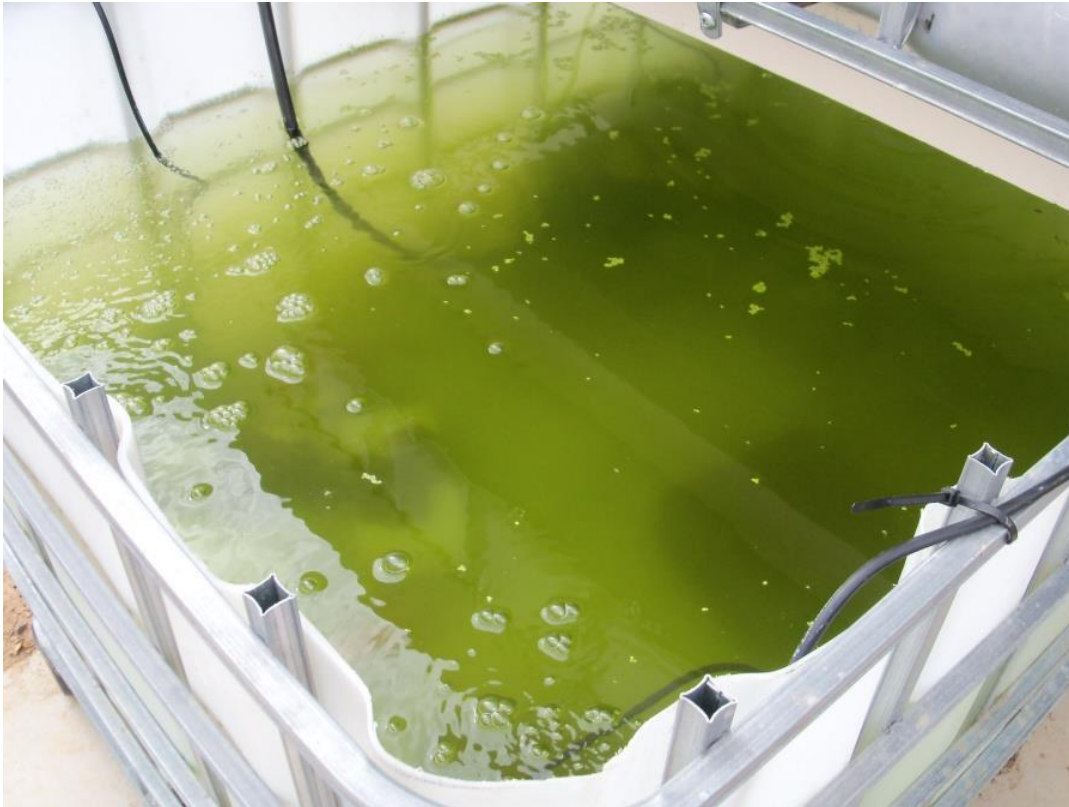
A typical IBC system your first time around is probably going to be a bit dirtier in the beginning. As you get the hang of things and tweak your system, that may change. When you are first starting out, it would be wise to start with some hardy fish that can tolerate your learning curve like goldfish, Koi or tilapia.

There are some main considerations you need to think about when it comes to taking care of your fish.

Algae

Some fish really like the algae and will do just fine, others will not. Fish like carp will do just fine with algae as will tilapia and goldfish. Trout, on the other hand, are not going to tolerate it well. You can often see the algae in the tank. You can test it by sticking your hand in the water. If you can't see your hand or it disappears after you push it down a bit, you will have a pretty good idea about how murky your water is.

Overly murky water is often the result of too much feed. You will want to cut back on how much food you are putting in the tank.



Broom Algae

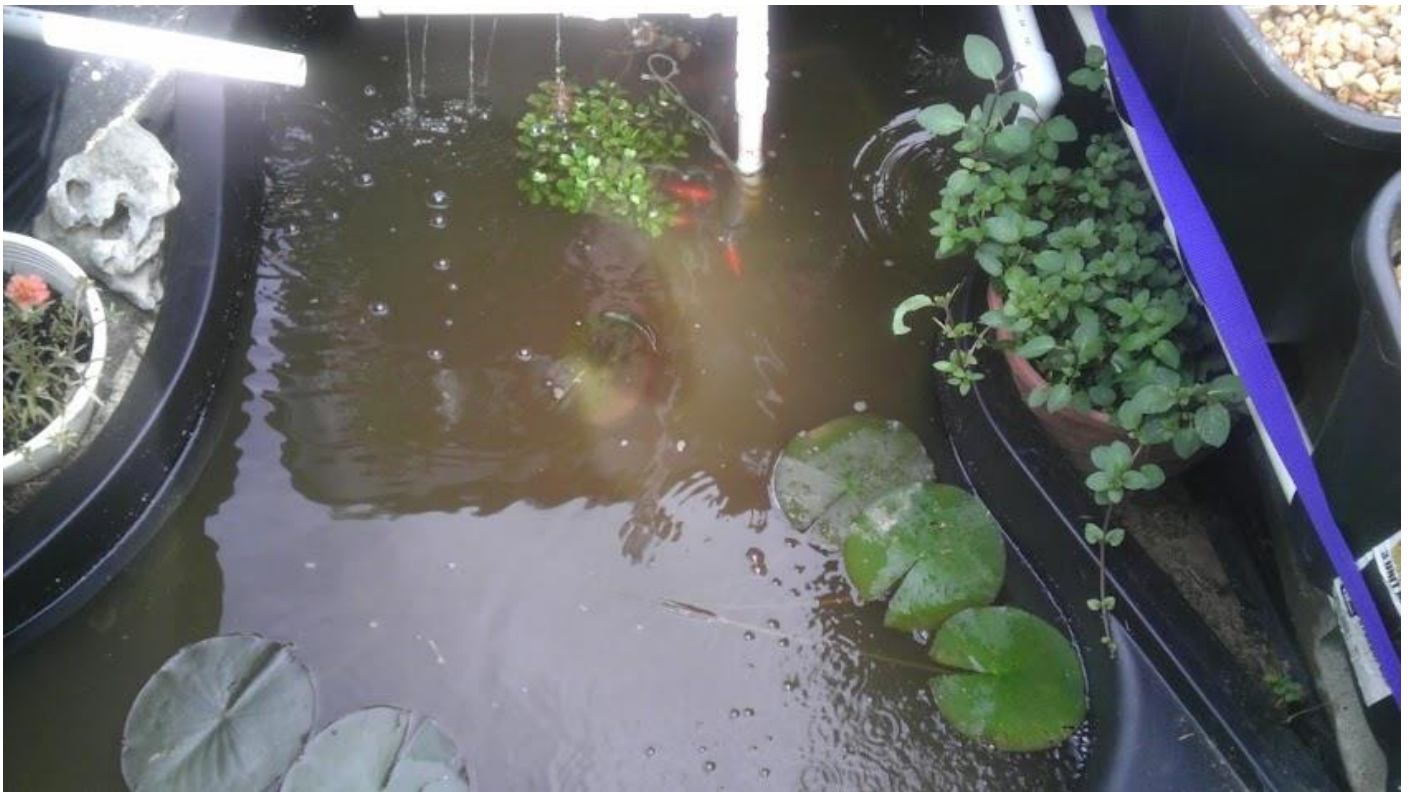
Water Quality

You need to stay on top of the quality of water in your tank. Clear water that is circulating is going to contain the right amount of oxygen for the fish. If there isn't enough circulation, ammonia can build up and kill the fish. It is also important you don't let your water get too warm, which will promote algae growth.

If you notice the water getting murky, you need to take a close look at your circulation.

The water needs to pass through the plants' roots to help filter and perform nitrification. Keep a thermometer in the tank so you can monitor the temperature and ensure it is the perfect temperature for your chosen fish. Do some homework before you buy the fish to make sure you can accommodate their desired temperature ranges in your tanks.

You will also want to purchase a water quality test kit. It will test for nitrate, nitrite and ammonia levels. This will tell you that condition of your water and alert you to high levels that will become toxic to the fish.



Murky Water

Best Fish by Region for Survival

Aquaponics

Before you start buying fish, there are a few more considerations to ponder. We already talked about the type of system you can offer your fish, but you also need to think long-term, after a major disaster when you won't have access to commercial foods. For this reason, an omnivorous fish is a better choice because you can forage for the food your fish will need to thrive.

Let's talk about the best fish based on the region where you live.

North

In the north where the temperatures tend to be chilly, carp are a good choice. They will do okay with cold water and are very easy to care for. In fact, they are so hardy they are considered an invasive fish because they can quickly take over a water source.

Carp are also very prolific reproducers, which is going to be a very good thing. You want fish that will continue the life cycle without a lot of help and encouragement from you.

Goldfish and Koi are also great cold water options. Koi and carp will both reproduce pretty steadily, but you will definitely need to do some research to

figure out exactly what they need to reproduce. Goldfish are easy breeders and really just need a little sun and a nice substrate to continually reproduce.

South

Tilapia are always going to be a first choice for warmer climates. They are so easy to care for and very forgiving. They are also very excellent breeders. Nile tilapia crosses are perfect and because they are so prolific, you may be able to catch a few at your local watering hole and bring them home to your tanks. Because tilapia are so common, a quick search of any aquaponics fish forum will return plenty of results from those willing to depart with some of their fingerlings.



Nile Tilapia

Breeding is going to be essential to keeping your aquaponics system sustainable. In today's world, it isn't as important because you can just go buy more, but in a true survival situation, you need your fish to continually reproduce.

Where to Buy Fish

Buying fish for your system should always be done on the up and up. You want to be legal, just in case. In some regions, it will be a piece of cake. In others, not so much. Your first step is to visit the fish and game site and read through their laws.

You will likely need to fill out a form to obtain an aquarium permit. This is usually easiest in the north if you want to have tilapia. You may be lucky and not even need a permit at all. It all depends on which state you live in and what they determine to be a risky fish for a shortage.

Fish that are fairly easy to legally buy are trout, crappie bluegill and channel catfish. Nobody is worried about them. However, invasive fish, like tilapia in the south and carp in the north, the process to buy these fish is going to be a bit more difficult. Fish and Game don't want any more of these fish to find their way into the water.

Hatcheries

Once you know what fish you can own, you can start shopping. Certified hatcheries are a great place to start. You can find these hatcheries listed on your fish and game website. You will be able to buy fish directly from the hatchery.

Check with the fish and game site to make sure there are no comments about the hatchery having issues with disease. You want to start out with healthy fish that are not going to give you any issues.

Fellow Hobbyists

You can check around to see if anyone in your area already has a stocked pond or an aquaponics system. They may be willing to sell you some of their stock. Before you make any purchases, you will want to ask them about any diseases or trouble they have had with their own system. If they will let you see the system, that is even better.

You can get an idea of the clarity of water and how they fish are acting. Do what you can to avoid buying sick fish that could contaminate your entire system. Do not be surprised if new fish you bring home act a little sluggish in the first day or two. That is just the stress of a new home.

Catch Your Own

If you want to harvest your own from the wild, that is an option if the fish you want are native to your area. You will need a permit to do this. Only do this if you can get a permit to catch and take home live fish with the intent to stock them in your tanks.

Introducing the Fish to Their New Home

Before you can bring your fish home and get them all tucked away, you need to have already had your system up and running and cycling through. You need to have the right amount of bacteria in the system to keep the ammonia levels down. Introducing fish to a system that hasn't been cycled through will leave you with a lot of dead fish.

You probably don't want to hear this, but it takes at least 6 weeks to cycle your system. You will need to wait at least that long before you introduce fish.

Adding the Fish

It isn't all that difficult to add fish to your tanks. You will want to add a few fish at a time so as not overwhelm the system or your fish. To reduce the stress, you will want to acclimate the new fish to the current temperature of your tank. If the fish are in bags, float the bags in the water for about an hour to help them get used to the tank temperature.

If you want to test your system, you can buy feeder goldfish at the local pet store. They are very inexpensive and a good way to make sure your system is ready for fish. Put the goldfish in the tank and watch how they do for a couple of days.

Check the ammonia levels to see how your circulation system is working. If all is well, add your first round of fish.

Feeding Your Fish

Do not make the all too common mistake of feeding your fish too much. This will cause serious problems with the delicate balance in your water. Only feed your fish small quantities of food. This will take some trial and error. The right amount of food is enough that the fish will consume it within a minute of it being in the tank. If there is still food floating in the tank after a minute, it was too much. Scale back for the next feeding.

Don't let the extra food sit in the tank. Scoop it out with a net. It is important to point out that fish don't have to be fed every single day and you don't have to feed them the minute you put them in the tank. Wait a day or two after you have introduced your fish to your system before you start feeding them.

Breeding Your Fish

You have to have a replenishing supply of fish if you plan on using your system for survival. It will also save you money if you can breed your own and not have to replenish your tank with fish you buy. This can be a very trick venture or very easy. Nature will generally do the work, but you will need to provide the right environment for your fish to breed.

You need to do some research about the breeding habits of the fish you have. There are a couple different ways fish will breed.

There are egg scattering fish, like trout, that lay their eggs on gravel. Carp and Koi essentially glue their eggs to rocks, branches and weed and then there are some fish who hold the eggs in their mouth until they hatch. Tilapia are mouth brooders. The female lays the eggs, the male comes along and fertilizes the eggs and then the mother sucks the eggs into her mouth. She will not eat during the egg incubation period. Once the eggs hatch, she will continue to hold the fry in her mouth as she swirls water around them. When they are ready, she spits them out.

It is imperative you know the breeding rituals of the fish you plan on stocking in your tank. You also need to make sure you have mature males and females. You cannot expect fingerlings to breed.

You will want to have things in your tank that will promote breeding. The right substrate will be important. If that is gravel or branches, make sure you have it in the tank. You also need to make sure the water is clean and well-oxygenated. The right pH levels and the right amount of sunlight are also critical factors to promoting breeding.

Some fish, like trout, need a little more help and convincing. Commercial hatcheries will often manually spawn trout. This is done by using a hand to squeeze the eggs out of the female and then squeezing the males to fertilize the eggs.

Some fish will be prolific breeders while others are going to need additional help. Do some studying about the breeding habits of the fish you want in

your tanks. If you don't mind a little manual effort, you can go with a fish that isn't known for easy breeding. You may also need to invest in hormones for your tanks. Know beforehand so you don't find yourself dealing with a situation you were not prepared for or willing to take on.

You will also need to establish another tank designated for breeding. This allows you to maintain the balance in your tank. Males tend to get aggressive during the breeding and could stress out your other fish by chasing them. Your females will want some quiet space. When you separate the fish, you are also getting to handpick your breeding pairs. You can create the best stock when you decide which fish to breed. You can have a single male and several females in the tank if you choose.

Once the egg hatching has commenced, you will want to pull the males out of the tank. They will eat the fry. If you are breeding in the same tank as the rest of your fish, you risk the other fish coming along and eating the eggs and eventually the fry. Remove the adults from the breeding tank as soon as you can to ensure the safety of the fry.

If you want to have more control over the breeding of mouth brooders like tilapia, you have some work to do. Once she sucks up the fertilized eggs, you will want to retrieve them and hold them in incubation jars. You can do this by using a net to chase her around the tank and she will release the eggs or just put her in a jar and wait for her to spit the eggs out. If that doesn't sound appealing to you, let nature take its course and let the female hatch the eggs in her mouth.

It is much easier even if the yield is a bit lower. The whole process is much easier and more natural if you let the mother do her job. Once the fry start hatching, use a net to remove them from the tank and put them in a safe place.

If you are breeding fish that prefer to lay their eggs on substrate, once the eggs are laid, you are going to have to remove the substrate and eggs from the system and put them in a different tank. Koi will want to start breeding when the temperatures begin to warm. They will need shallow water and rocks, branches or plants to lay their eggs in.

You can buy something called a breeding mop. The mop resembles weeds, which will attract the fish to lay their eggs. Once they have laid the eggs, you can gently remove the breeding mop and put it in a different tank. This will keep the eggs safe from other fish eating them. You can do this with any branches or other weeds they may have laid the eggs in.

Fish that scatter their eggs are a bit more difficult to manage. If you are going to go with this type of fish, you are probably going to want to do the manual fertilization method. It is a pretty complicated ordeal that isn't going to be covered here.

In any breeding situation, you will want to remove the fry as soon as they hatch. The fry will not need to be fed for the first few days. Their bodies feed off the yolk from the egg they were in. You will see this little bubble, which is the yolk. Over a period of days, the yolk will shrink and your fry will be

ready to eat. They will be quite hungry so make sure you have a high protein source of food on hand.

This is a very sensitive time for the fry and the water in your tank. You don't want to over feed and cause ammonia levels to skyrocket. You also don't want mold to develop. Sensitive fry will die quickly if the tank becomes even slightly off balance. One of the best choices for feeding your fry is something called fry powder. If you don't have the high-protein fry powder, you can grind up your other high-protein food and feed that to the fry.

Unfortunately, fry are hungry, but they cannot always find the food. The powder will quickly be cleaned away by your filtration system before the fry can find it. Another option that some people use are actual egg yolks. Boil a few eggs and place the yolks in the tank. The yolk will float at the top and the fry will eat away at it.

Live feed is a really good choice. Aquatic plants are also beneficial because they not only feed the fry, but will help filter the water and reduce ammonia levels. Zoo plankton is also a good idea. These are basically tiny little animals that are in the water cleaning some of the bacteria. The fry can feed on them. Live food is a good option because it doesn't run the risk of polluting your water like a dead food source.

Phytoplankton is basically algae, which fish like tilapia will love. Duckweed is another option. However, the duckweed and phytoplankton alone are not going to be enough for your fish.

The fry will still need a source of high protein. The plants and algae are more to help keep the ammonia levels balanced in the tank.

It doesn't take long before your fry grow into fingerlings. When that happens, it is time to move them to a bigger tank. They will need to be moved several times in order for them to continue growing. The tanks should be big enough for each fingerling to have plenty of room and plenty of food. You don't want them having to fight for resources or space. Your fry will grow fairly quickly. You can taper back on the high protein food once they get almost full grown.

Breeding isn't as complicated as you may think. Nature will take care of most of it for you. Always research the fish you have and learn about their breeding practices. There may be some trial and error in the beginning, but it is pretty easy once you get the different tanks figured out and know just how to feed them.

Best Veggies for Aquaponics Systems

Your aquaponics system is going to be your vegetable source. There are some vegetables that will grow better in an aquaponics system than others.

The key to remember is you can probably grow just about anything in your system, but you want to stick with what is best and most appropriate.

You also need to consider where your system will be set up. If it is outside, you need to choose plants that can handle the climate in your area. An indoor setup is going to give you a lot more choices.

You are really not limited if you can create a nice growing environment. The amount of light your plants will get will be important. If your system is set up in the basement, you will need to invest in artificial light.

Easiest Veggies

Some of the easiest and most common vegetables grown in an aquaponics system are leafy greens. They are prolific and require very little care. Those include;

Each of those leafy greens will grow several months and you can harvest throughout the growing season without killing the plant.

Some people do like to grow root crops like beets, radishes, carrots and so on.

Those are a little trickier. Fruiting vegetables like tomatoes and cucumbers are an option, but they are a little more labor intensive than the leafy greens.

They demand more nutrition than lettuce and other leafy vegetables. When you are just getting started, your system isn't going to be quite ready to support the demands of fruiting vegetables. Once the system is established, you can give it a shot.

Another consideration for the fruiting vegetables is the pollination needed to actually produce fruit.

You will need to use manual pollination if your system is indoors and bees are not around. Strawberries are a popular crop in an aquaponics system, but you will need to either use a paintbrush to pollinate the plants or brush the flowers against each other.

- Kale
- Lettuce
- Mustard greens
- Collard greens
- Spinach



Lettuce and Spinach

Before you start buying random seeds, you will want to do some research about the numerous varieties. A cucumber is not just a cucumber. There are plenty of varieties and you want to choose one with a growth cycle that works best for your system setup and your climate. Check with local growers and the expert gardeners in your area to find out which varieties grow best in your area. This will help ensure your success and means you will have food to put on the table.

You will also need to think about whether or not you want to start your plants directly in your aquaponics or whether you want to start the seeds outside of the system and then transplant the starts. In the beginning, it may be best to start the seeds outside the system just to save space and let you get the hang of things.

Don't plant random vegetables just because they are easy. Only plant vegetables that your family will actually eat. This is a rule in survival gardening that you need to apply to your survival aquaponics system.

Lastly, do what you can to stick with heirloom vegetables. This way you can save seeds from each crop so you always have a supply of seeds to plant for the next cycle. You should only have to buy seeds one time. Hybrids are not a good option for a survival system. Hybrid seeds cannot be harvested from a crop and planted the next season. They will not produce plants or fruit like they did when they were cross-pollinated to create whatever the hybrid vegetable was.

Your system should be fairly self-sustainable. Your fish will continue to reproduce and your plants should produce seeds that ensure you have food for years to come.

Caring for Your Plants

Like the fish in the tanks, your plants are going to need some tending. They have their own specific needs and you will want to be prepared to fulfill those needs. Plants that don't have the necessary nutrients will wilt and die. Plants have three basic needs; water, light and nutrients. You must be prepared to provide those things because you will not be using the standard soil.

Your aquaponics system is set up so the plants will get their nutrition from the fish waste. This is what makes it so beneficial. The plants filter the water and the fish feed the plants. In an ideal system, the plants will be green and thriving without any help from you. The fish will take care of all of the nutrition. However, the tanks may be a little off and you will need to add supplements to help your plants grow.

Plant Supplements

There are a few main things your plants will need that may not be provided by your fish waste.

- Calcium
- Potassium
- Magnesium
- Iron

There are a few ways you can add these items to your plants without hurting your fish.

- Agricultural lime will help provide additional calcium
- Potassium chloride is great for potassium
- Caustic lye is another way to add potassium
- Epsom salt is great for adding magnesium
- Chelated iron adds iron

These supplements are very easy to find. You can check your local drugstore, hardware store or even the dollar store. The nutrients act quickly and you should see a noticeable change in the condition of your plants within a few days of adding the nutrients.

Oxygen

Plants need oxygen in order to thrive. Many people ignore, forget or don't realize that plants are aerobic. The leaves and roots need oxygen to survive.

Without oxygen, it creates what is known as anaerobic conditions and the plants will suffer, wilt, rot and ultimately die.

A plant this is struggling will be too susceptible to disease, which could negatively impact all of the plants in your system. The key is a good design. You need the water to constantly be circulating. Stagnant water can lead to low oxygen levels and serious problems.

Nitrates

Nitrates are a great thing and are already going to be a part of your system. However, you will want to monitor the nitrate levels to make sure it isn't too high or too low.

Levels that are too high, mean you are producing quite a bit, which is a good thing, but it also means your plants are not able to absorb it quick enough. That means you need to cut back on how much you are feeding your fish, just a bit to try and even the levels out. Your fish will do okay with high nitrate levels, but it can lead to disease as well as aphids and algae blooms. Aphids can destroy plants very quickly. If you see aphids, you will want to take action to scale back on the nitrate level.

Pollination

This was mentioned earlier. Plants will need pollination so you need to be ready to do that. A paintbrush or just gently blowing on the blooms is usually enough.

Lighting

Lighting is going to be a very big deal. If your system is set up outside, this

shouldn't be a problem. The sun and nature will take care of the lighting your plants will need. If your system will be indoors, you will need to supplement the light for proper growth. If your system will be in a greenhouse, you shouldn't need to add additional light.

The type of lighting you choose is going to depend a lot on what you can afford and how much electricity you have to offer. If you only have a single breaker to dedicate to your lighting needs, LED is the best way to go. They are more expensive up front, but use very little energy, which will save on your monthly electric bill.

There are a couple of other options; fluorescent lighting, high intensity metal based lighting, and metal halide lighting systems.



Metal Haliade Lights

Each of these systems will produce quite a bit of heat. It is important you don't overheat the water or your plants. The good thing about the heat production is it can be enough to actually heat your home. They suck the electricity and can be very expensive to run on a monthly basis.

Proper Plant Nutrition

As your plants grow, their nutrition needs change. It is important you adjust your nutrients depending on where your plants are in their life cycle. In the early stages, the plant is in its vegetative state where it is focused on growing leaves. Lettuce and kale stay in a vegetative state for the majority of their life cycle.

Plants like tomatoes, cucumbers and strawberries are encouraged to reach the reproductive growth stage where we see the actual food on the plant. When fruiting plants reach this reproductive growth state, they are going to need more potassium and phosphorus. You will need to account for this in your system.

One way to supplement the potassium and phosphorus is to add seawater or seaweed extract. This is a quick, easy and effective way to get your fruiting plants what they need to thrive and produce delicious fruits.

Compost or manure teas are also an option. It all depends on what you like and what is available to you.

Starting Plants from Seeds

There are various ways to start your plants for your aquaponics system. Tiny seeds, like lettuce and kale, are very easy to start in your media, like gravel. You simply sprinkle the seeds over the gravel. The seeds will fall into the crevices and take hold. The moisture in the media will be enough to sprout the seeds. You will find you end up with more sprouts than you need in an area and will need to thin the plants out a bit.

It is a good idea to remove the tiny seedlings and allow the bigger ones the space to grow. If you don't thin them out, you will end up with a lot of seedlings that don't have the space or nutrients needed to turn into mature plants.

Plants, like lettuce, that grow into heads will need more space than something like kale or spinach. This can take a little practice as you figure out just how much space you need to achieve the desired results.

Jiffy pellets are a handy tool that many aquaponics hobbyists use to start their plants. The tiny discs are made up of peat moss.

You drop your seed in, fill it with water and in a few days you can expect to see a sprout. The roots will grow in the pellet. When you are ready, you transplant the entire pellet and the root system into your aquaponics system.



Jiffy Pellets

Perlite or vermiculite are also media options that are great for starting seeds. Vermicompost is the product left behind after worms have gone through and eaten kitchen scraps. It is similar to compost, but contains extra nutrients from the worms and their casings.

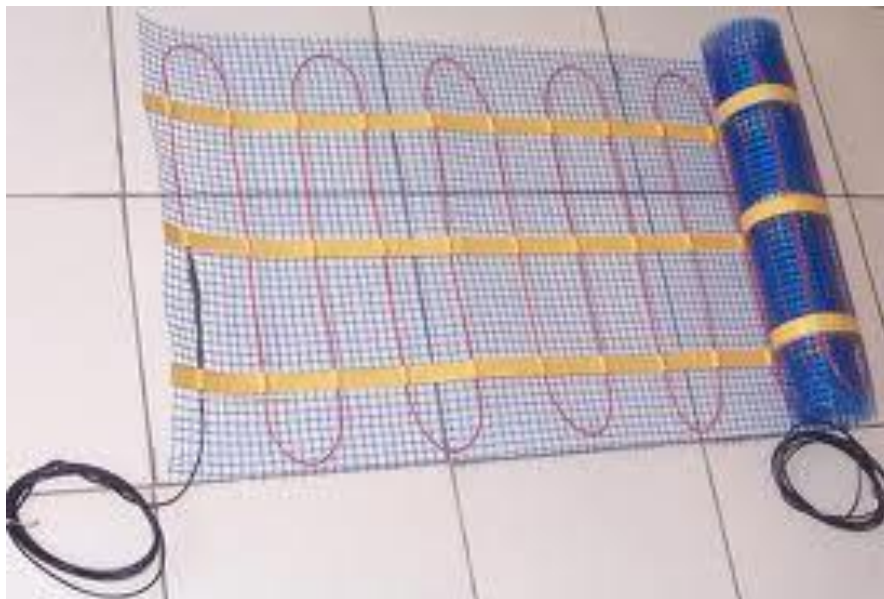
Jiffy pellets are really the ideal method. They have fine mesh that keeps the peat moss where it should be and not floating in your system.

The other media types will often break apart and crumble into your water, causing some problems. Plug trays allow you to plant a single seed in each pellet, which reduces the thinning you will need to do. This will ultimately save money on your seed cost.

Seed Germination

Getting your seeds to sprout requires moisture and heat. The seeds have to stay moist during the germination process, which means you will need to stay on top of the watering.

If you have a sunny window, the seeds will get the heat they need. You can control the heat a little easier with something known as a heating mat. This is a lot like a heating pad. You set it under your seed tray and it will keep the seeds warm while they germinate. You can also use grow lights that provide heat and light for those seeds that do sprout.



Heating Mats

Buying Seeds and Plugs

You can buy seeds and those peat moss pellets in a variety of places. As mentioned earlier, you want to do what you can to stick with heirloom seeds. Online retailers are often your best bet because you can order a variety of seeds throughout the year. The seeds are generally divided up by region so you know you are getting the best seeds for your region. You will also get to read detailed information about the plants and what kind of harvests you can expect. Some sites will include customer reviews that will give you even more information.

If you are buying from a local nursery, you can talk with the staff about what kind of plants would work best in your aquaponics system and whether there are any special considerations you need to make. You can also find seed banks that allow you to buy and then begin trading seeds with other people. Seed banks are generally always going to be heirloom varieties, which is what you want.

Storing Seeds

Once you have purchased seeds, you need to know how to store them in order to keep them in good shape and ready to plant when you are ready. If you are part of a seed bank, you want to make sure you are trading quality seeds that have been properly stored.

Your biggest enemies of seeds are light and moisture. You will want to keep them in a cool, dark and dry place. Storing your seeds inside Mason jars with lids is perfect. It will also keep any vermin out of your seed supply. You can keep your seeds in small packets and then store those packets inside a jar. Metal boxes with lids are also a good option.

Do what you can to save some seed from every crop. This ensures you always have seeds to use and it will be absolutely critical to your survival after a collapse when you can no longer buy the seed you need.



Mason Jars

Benefits of Bacteria

You may think bacteria is a bad thing, but it is actually very necessary and very helpful to your system. The bacteria are responsible for transforming waste into the stuff the plants need to grow and thrive. The bacteria floats on the surface in the water, floats in the middle and clings to the media in the tanks. When you have a nice balance of bacteria, your fish will be healthy and your plants will thrive. One way to ensure the proper balance of bacteria is to keep the water circulating rather quickly. Keep a close eye on the health of your fish and plants. Any signs of trouble likely mean your bacteria levels are off.

Different Types of Bacteria

Nitrifying-This is one of the most important elements of your tank. It works to transform harmful ammonia into nitrites and from there, the very beneficial nitrates. It helps to clean the tanks while feeding the plants. Keeping your tanks' water moving swiftly and keeping the pH at an even keel will promote the growth of this bacteria. If the pH drops too low, the bacteria cannot grow. Aim to keep your pH at 7 and the bacteria will thrive.

You also want to avoid exposing this particular bacteria to UV light. If you were to stir up the gravel in the tanks and expose it to additional sunlight or

your grow lights, you could kill the healthy bacteria. When you are doing any kind of work in the tanks, make sure you don't disturb the media and over-expose the bacteria to UV light.

It is also important you never remove all of the plants at a single time. Harvesting everything on a single day can throw off your bacteria levels. Do a little every day to prevent disturbing the growing environment for the nitrifying bacteria. You want to keep things on a healthy level at all times.

Mineralizing-This particular type of bacteria breaks larger bits of waste down into minute particles. Fortunately, this particular bacteria is pretty resilient. It isn't super sensitive like the nitrifying bacteria and is much easier to promote in the tanks. You will want to avoid shaking the tanks or stirring the gravel up too much, but other than that, this bacteria will thrive and do its job fairly well.

Pathogenic-This is the type of bacteria you DON'T want. It is dangerous and it will kill your fish. In order to prevent it from growing, you need the other types of bacteria thriving and growing happily. Pathogenic bacteria will not only sicken your fish it will also attack your plants and cause serious problems.

Starting the Bacteria

Now that you know you need bacteria, you need to know how to introduce it to your system. There are a couple of different ways. One of the most common and effective ways is to take water from an established, healthy aquarium or aquaponics system and pour it into your new setup.

This is only a good idea if you know the system is in good shape and doesn't have any disease or pathogenic bacteria. This helps the whole process of introducing and inoculating bacteria go much faster.

If that isn't an option, you have others.

Inoculants

If you can't get your hands on water, you can actually buy inoculants and introduce them to your system. This method isn't always full proof. The bacteria are sent in a bottle, which means the jiggling and light exposure may ultimately kill off some of the bacteria. It is up to you, but if you can get your hands on somebody's water, that is going to be your best option.

The inoculants you buy will often be sold as nitrifying bacteria. The only issue with this is the bacteria are not native to a particular system and are likely not going to stick around for long.

They will give your system a boost, but it isn't going to be ready as quick as it would be to pour in water. They inoculants will eventually adapt and take hold in your system.

To help the nitrifying bacteria really feel at home in your system, you are going to need to add ammonia to the water to feed the bacteria. This is fairly easy and can be achieved by adding food to the tank.

Once you introduce the inoculants, expect it to take about 6 weeks for them to take hold and balance out the bacteria in your system. You will know the bacteria are taking hold and doing their job when you start to see ammonia levels dropping. Your nitrite levels will jump a bit before you see them drop and your nitrate level increase. It is a process and the important thing is to remember to be patient. Let your system bacteria do its work and it will all balance out.

Red Worms



Red Worms

Worms are often added to aquaponics systems as a way to help break up those large chunks of fish poop into smaller bits that will help feed the plants. Worms in the soil are an effective method of breaking down organic material so the roots of the plants can absorb it. Worms are perfect for your aquaponics system as well. Worms will digest the larger chunks of fish poop that could take a long time to break down and make the system murky. They digest it and it comes out in tiny little worm poop that is much easier to process for your plants.

You can go with earth worms, but red worms are ideal. You can buy these online or visit your local farm and garden store. They will generally come in a container. Dump the container into your system and the worms will find their way into your media and get right to work. Red worms do not like the cold. They will not survive through the winter. You will want them in your system long before the winter comes.

Worms in the system are truly beneficial. When the large chunks of fish poop float around the tank or settle to the bottom, they can end up clogging your system. This can spell disaster if you don't catch it soon enough. Your system is like a finely tuned machine. One little problem will upset the entire balance. The worms will hang out in the media, keeping it nice and clean and the percolation in good shape. They can get the places you can't even see.

The worms will help you get the bacteria you desperately need established much quicker as well. Red worms reproduce fairly quickly and with no effort on your part. You will have a sustainable system for helping to keep your tanks clean and in good working order.

Don't worry if the worms end up in the fish tank. As you can imagine, the fish will be perfectly happy to eat them. It is all part of the cycle of life. The fish will eat the worms, which are an excellent source of nutrition. It feeds the fish and their poop in turn feeds the living worms.

Additional Animal Life

People like to get creative and expand their food choices by introducing other types of animals into the system. This is all personal preference. Chickens and ducks are common components of a survival aquaponics system. Chicken and duck waste is a big boost to the nutrients in the water that can really help plants thrive.

It is important to note that the more animals and plants you introduce to your system, the bit more complicated the system will be. That is a good and bad thing. More animals means more nutrients. However, it can also mean more algae blooms that can be an issue if you are not on top of things. You will find a section on troubleshooting problems with your system and how to correct the increase in algae.

Some brave people will take the introduction of animals a step further and incorporate pigs, goats and even livestock. This is definitely going to increase the nutrients in the water, but it can be very tricky business to properly clean the water. You don't want your produce to end up being contaminated with products that tend to be in large animal waste. If your produce is exposed to the water in your system and it isn't properly cleaned, it can make humans very ill.

However, if you have a great set up and something referred to as waste-fed agriculture, it will work perfectly. Human and animal waste is fed into a pond with the fish. The fish feed on the algal blooms that are created. It is a system that is very common and sustainable. Human waste is an option, but if you don't need to, it isn't recommended. You could be introducing E.coli into your food and water supply.

Always use sterile equipment to cook and clean the food you harvest. Cook the fish to the correct temperature and always wash everything before you eat it!

Water Plants

Plants in the water provide a little more filtration. Earlier we mentioned duckweed as an option. It is a very common addition to many systems and it can be quite beneficial. It can actually be eaten by humans, which adds another food source to your system. Omnivorous fish, like tilapia, will also like it.

Duckweed will produce quite a bit. However, when it is wet, it looks like a lot of food, but when it dries, it isn't nearly as much as it originally appeared. You need to take this into consideration when you are counting on eating the duckweed or using it to feed your fish. It is much smaller than it appears.

Duckweed is plentiful and it will continue to reproduce as long as you let it. It makes an excellent food for livestock, pigs, ducks and chickens.

It is high in protein, which is always a good thing when you are feeding animals. If you are planning to use your aquaponics in a survival situation, this is a great way to supplement your diet as well as those of your farm animals.



Duckweed

The duckweed is also a great way to help you manage algae blooms. The duckweed forms a bit of a layer over the top of the water, which will help limit the light to the water that promotes algae growth.

Water hyacinth is a nice addition, but it may not be legal in your area because it can be incredibly invasive. It is very pretty and can add a little extra flair to your system if you want. Fish like tilapia will love it as well and will eat it.

Like the duckweed, the water hyacinth will create a nice bit of shade over the top of the water and help cut down on the algae.

You can find a variety of other plants to add to your system through talking with others and doing some online research. It is important to keep in mind that every plant in your system is going to use the nutrients in the water. If you don't plan on using duckweed or other plants to feed yourself or your farm animals, you may want to think twice about adding them to your system. You will be taking nutrients from the vegetables you are growing. Yes, they can all live together and thrive, but it needs to be a good balance.

Choosing the Location

Location, location, location! Where you set your system up is going to be very important. It isn't like you are going to pick it up and move it if you don't like the area. If you live anywhere other than tropical zones or southern areas where the winter is extremely mild, you need to think long and hard about placement. You don't want to go through all the trouble of getting the system up and running and perfectly balanced just to let it die over the winter. You would be starting all over again. Plus, for survival aquaponics it is critical to your survival that it is placed somewhere it can operate all year round.

Sunlight

Some people choose to set their systems up inside a greenhouse. This is a great idea, if the greenhouse is in a good location. If you are investing in a greenhouse, you need to know the best place to set it up to get as much sun as possible. You need to track the sunlight from within an hour or so of it rising until it sets. This will allow you to get an accurate idea about how much sunlight the greenhouse will be getting throughout the entire day. Watch for shadows. If you discover a shadow persists from a tree or a building, look for another location. This is especially important for the winter. With short days, you need every bit of sunlight you can get. Track where the sun hits in the winter if possible. You definitely don't want to have move the greenhouse and your aquaponics after discovering it gets too much shade.

Heating a Greenhouse

In the dead of winter, light from the sun isn't going to be enough to keep your tanks warm and your plants alive. You will need to consider how you will heat the greenhouse. You need to consider this carefully if you are planning to go the greenhouse route. It can be expensive heating the greenhouse all winter long.

If you are going to have fish that are cold tolerant, you could go with the high tunnel style of greenhouse. You can supply very little or no heat at all and your fish will still be okay. Trout are a fish that would be okay on cool nights.

If you are going with fish that need a little more warmth, you have to figure out a way to keep your greenhouse warm. People have gotten pretty creative. Livestock in the greenhouse will generate heat—if you can keep them out of the tanks. You can also use compost, which creates a very small amount of heat as it breaks down.

Natural gas heaters are pretty common, but that is an expensive route. You will need to pay to have the greenhouse outfitted for natural gas. Another option is to use a wood-burning stove, which can also be a little difficult to manage.

Folks in the south who get a lot of sun exposure and mild winter nights can rely on the sun to keep the greenhouse warm throughout the day and night. You could also use solar energy that powers heaters.

Temperature

One of the biggest concerns here is you don't want to get really big temperature fluctuations throughout the day. This will wreak havoc on your system. You want it to stay at a pretty even keel all day. Avoid putting your system anywhere the wind will be strong. You don't want the wind blowing through and cooling the water. Along with that, you don't want birds dropping by for lunch or extra protein finding its way into your water. If they system is going to be outside, it needs to be sheltered. Avoid placing it somewhere that it will be in the shade for the majority of the time.

Indoors

If you simply don't have the space outside or in a covered patio area, indoors are an option. However, the tanks are going to need to be a bit smaller and you need to think very carefully about the weight of the tanks. The smaller systems tend to be a little more difficult to maintain as well, which is why a lot of people prefer not to have an indoor aquaponics system.

If that is your only option, you can make it work. You will need to go light on the media. Gravel is going to be very heavy and when you factor in the weight of the water, it can cause serious problems. Your best choice would be hydroton. If you need to move your tanks, you could drain some of the water out of the grow bed and fish tank and drag it if you needed. It isn't easy and you do risk upsetting your system.

You will definitely need to have artificial lighting. As was mentioned earlier, LED is the most energy efficient, but it does cost a lot more up front. If you are in this for the long haul, the LED is going to be worth the extra money up front.

Optional Locations

Growing anywhere outdoors is going to come with some additional concerns. You will need to think about the weather and how you will protect your setup from hail, snow, rain and strong winds.

If you are growing in your basement, shed or any other small space, you need to think about how you are going to get to your system and get around it.

There are going to be times you need to make adjustments and repairs and you will need easy access to all sides.

If you live in a small house with a small yard or even in an apartment, you can do some research into micro systems. These smaller setups can be put on a patio. They are just as effective, but on a much smaller scale.

Another popular choice for those who have limited space is to use the rooftop of their building. This is only a good option IF the roof is well built and can handle the extreme weight of an aquaponics setup. Most roofs are not and you could end up with a huge disaster. There is something known as vertical technique or NFT that allows you to create a system that is very lightweight and perfect for places where the weight is going to be a problem. The system is basically the same, but the tanks are going to be designed to spread the weight across a large surface area rather than concentrated in one space.

Lastly, you need to make sure you protect your fish and plants from animals who will see your tanks as their personal grocery store. Raccoon, bears and birds will all love to go fishing in your tanks. You also need to consider human thieves that will take what they want or even vandalize your system. Think long and hard about how you will secure it from trespassers. Keeping it out of sight is one way to do that.

Hardware Needed to Get Started

Okay, now let's talk about building your system. One of the most common setups includes an IBC design.

That is using those barrels that are cheap and easy to work with. Many, many aquaponics hobbyists use these barrels or have used them in the past.

The following are the basics you need to start shopping around for.

IBC Barrels

Check around. Don't be afraid to look on Craigslist or ask restaurant owners if they have any they would be willing to sell. You can buy them from actual dealers as well, but you can expect to pay a bit more.

Expect to pay anywhere from \$50 to \$200, but if you can find them for even cheaper if you look hard enough and get really lucky. Have soap and water available so you can wash the barrels once you do get them.

Pumps



A pump will quite literally what makes the world go round in your tanks. You need to pay attention to how many gallons per hour the pump will push and the head height. Buy a pump that will be appropriate for the size of the system you will be building. A submersible pump is your best option.

It will sit in the water with a pipe that sticks out, which you will attach tubing to. The EcoPlus tends to be a favorite and is very reliable. Two of the better designs of the EcoPlus are the EcoPlus 385 and the 296. They have the ability to adequately push the water up and out of the tank at a fairly steady pace, which is what you need to keep the water circulating.

Keep in mind, the higher the head height, the less water you will be moving per hour.

If you need to push your water up two feet to your grow tank, keep that in mind as you are shopping for a pump. Most of the pumps will have a chart that outlines how much water they can push based on how high up it is going to moving.

Tubing



$\frac{3}{4}$ inch tubing



$\frac{3}{4}$ inch fitting

You are going to need about 6 feet of black polyethylene tubing at $\frac{3}{4}$ inches around. This stuff is really inexpensive. You can go to Home Depot or a similar store and buy it by the foot for less than a dollar a foot. You can use 1-inch if that is all that is available. This quick list will help you grab what you need all at once. If you use one inch, make sure you adjust the fitting for the tubing. You will be in the plumbing and irrigation aisles to find these things.

- 6 feet $\frac{3}{4}$ black polyethylene tubing
- 3 barbed $\frac{3}{4}$ inch L fittings.
- 3 feet 2 inch PVC pipe
- 1 2-inch female-threaded-to-female slip coupling
- 1 2 inch female-slip-to-male threaded coupling
- 10 inches of 4 or 6 inch septic PVC pipe, anything thin walled will work

- 1 ¾ inch L-barbed-to-male threaded fitting
- 1 inch T with female threaded to slip on either side
- 15 feet of 1 inch PVC (this will run you about 8 bucks for a foot)
- 4 1 inch L slip-to-slip couplings
- Teflon tape

While you are at the hardware store, you will need to pick up 2 10 foot 2x4s. You will be cutting these in half.

Tools Needed

If you don't already have these tools, maybe you can borrow from a friend. You can always buy if you have the funds.

You are sure to use them again in the future to make repairs and adjustments to your tanks.

- Drill, corded or battery operated will work with ½ drill bit
- Angle grinder with cutting disk, you can also use a reciprocating saw
- Jigsaw
- Hole saw with 2 ½ inch fitting—can use a jigsaw if need be, you could also get away with using a drill bit to start the hole and grinding it out for your 2 inch couplings
- Tape measure

- Permanent marker
- Pipe cutter—technically you could use a reciprocating saw but you risk damaging the pipe. The pipe cutters are less than \$10 and worth the cost.
- PVC pipe weld or pipe glue—you only need a little so stick with the small bottle
- Heat gun—can use a standard hair dryer if you have one
- Safety goggles and gloves will help protect your eyes and hands

Media

Now comes the hard part—choosing what media you will use in your beds. You have plenty of options and each have their good and bad points.

Crushed Granite



This is easy to get and very inexpensive. If this will be your choice, you will need $\frac{3}{4}$ inch crushed gravel. You can buy washed or unwashed road gravel. The unwashed is cheaper and if you don't mind washing it at home, you can save some cash. This is a cheap method, but it is heavy. The heaviness of the rock can cause some problems in your system. It is also tough on the hands when you need to move the often sharp rocks around in the tank. However, you can make it work.

Expanded Shale

This option is a bit more on the price scale, but it has its benefits. Expanded shale is rock that has been mined and then heated to a point it expands. The process is a lot like popcorn kernels exploding into fluffy bits of popcorn. It is lightweight and provides plenty of surface area for your bacteria to grow.

Hydroton

This the prime media option and as you can expect, it is going to cost you quite a bit more than the gravel option. These little Terra-cotta clay balls are super light and so easy to work with. The only real drawback is the price and the fact they do tend to float. If you have oodles of cash, this will be your number one choice. If you don't, the expanded shale should be at the top of your list.

For the purpose of this tutorial, let's assume you are going with expanded shale. It isn't the cheapest, but it is the better option over the gravel. When you head to the rock yard, you will want to buy half a yard for your tanks.



Creating a Self-Sustaining System

The whole idea of a survival aquaponics system is to be completely self-sustainable. You don't want to worry about running to the feed store to get what you need to feed your fish, buy seeds or even use electricity. You want the system to essentially run on its own. This is one of the main reasons people introduce duckweed and other larger animals to the system. It creates a source of food to feed the fish and the fish feed the humans while providing the nutrients for the plants.

This is an excellent theory, but you have to remember that introducing duckweed to your system is going to rob some of the nutrients from the plants. Yes, you can compensate and you can still make it work.

Just remember when you add more plants, you are going to need more nutrients. If you add more fish, you need more feed.

Solar Powered Pumps

Solar power is a dream for many aquaponics hobbyists. It is the freedom to leave for a week and not have to worry about a power outage happening and disrupting your entire system. It means your electric bill isn't going to jump sky high when you add all the components of your system.

Unfortunately, the thought is an expensive one. It is a big investment right out of the gate and not everyone is up to spending that kind of money. You could start out on the light side and have solar panels that only run your pump during the day when the sun is out. Technically, your plants wouldn't need the circulation at night.

One of the most expensive parts to a solar-power system are the batteries that store the converted solar energy. This is what your system would rely on at night or on cloudy days when the solar panels are not able to collect enough electricity to run the pump.

Wind turbines are another option, but again, we are talking big dollars up front. Sit down and crunch some numbers before you make a decision either way. If you are really going to depend on your aquaponics system for a food source, then it may be worth the money. If you live off the grid, you don't really have a choice and will need to figure out how to accommodate the extra electricity your pump will need.

Auto-Feeders

You don't want to be a slave to your aquaponics system. You will soon find yourself saying it is too much work and you will likely give up on it. Investing in a few tools that help make your life easier is a good idea. One of those things is an auto-feeder. There are plenty of brands and varieties out there. The key to remember is your auto-feeder is more like a babysitter—not a nanny. Use them for a few days when you need to go away, but when you are around, it is best if you are in control of the feeding.

You can buy auto-feeders that are programmed to release food at a certain time or in various intervals. This still gives you some control. Other feeders are on-demand. When the fish are hungry, they bump a small wire at the end of the cone that releases food into the tank. As you can imagine, the fish can overeat if they are given free reign over the food supply. Your fish may end up going through all of the food in a day and have nothing left for the last 2 days or whatever the case may be. Your water will sour and if you are not there to quickly remedy it, things could go very bad.

The on-demand feeders are pretty common. People like them because they are much cheaper than the kind you can program. However, the programmable feeders give you way more control and you don't have to worry about the fish overfeeding and disrupting your entire system.

It is important you don't let auto-feeders completely take over your system.

When you feed your fish, it gives you a chance to watch them and make sure they all look happy and healthy. You will recognize signs of trouble and be able to take action each time you feed. If they are not eagerly swimming to the top to get the food, you will know something is up. Auto-feeders are great and they have their place, but never let them take over and steal away all the interaction between you and the fish. You could end up missing something big.

Hand Feeding

The best option you have for feeding your fish is something referred to as feeding to satiation. This means you are the one in control of how much food your fish get at a single setting. This is an especially good idea in the beginning when you need to get to know your fish. It means you feed your fish until they stop eating. As you do it more and more, you will be able to determine just how much they need at a single feeding.

The idea is to feed them until they are almost full. Once you figure out what the magic amount of food is that makes them full, scale back. You want to feed about three quarters of what they need to be full. This way you don't worry about any extra food being left in the tank.

With auto-feeders or on-demand feeders, you may end up with too much ammonia in the tank because the fish are not eating everything that is put into the tank.

Additional Options

To help make a system a little more self-sustainable, some hobbyists will insulate the tanks. Adding shade over the tanks is another way to help keep them in good shape if you are not there to monitor the situation. Having the tanks in a greenhouse is another way to make them a little more self-sufficient because you won't have to worry about the proper amount of light or warming the tanks. These are options to think about if you want to be able to get away for a weekend.

Ideally, it would be best to have someone you trust look in on your system on a daily basis if you are going to be gone more than a few days. If a pump breaks or something gets clogged, your system will fail and you could lose it all. If a fish dies, you don't want it floating in the water for days. This can throw off your pH and upset the entire ecosystem.

Ask someone to look in, test the water and ensure everything looks to be in good shape. You will feel better and you are training someone else on aquaponics.

Starting with the Right Water

Obviously, one of the most important components to your aquaponics system is the water. You need to fill your tanks. Most people are going to use the garden hose to fill their tanks, which is okay, but you need to know what you are working with when you pull water straight from the tap.

Generally, the water you pull from the tap is going to have a high pH. This is not going to be a good starting base for your tank. The water pulled from the ground is coming through various carbonates and limestone, which is going to jump up the pH level. You want to get started on the right foot, so you need to test the water that comes out of the tap.

Carbonates are generally a good thing, but in this particular case, they may cause problems. Carbonates tend to increase the pH in the water. Your plants are not going to be nearly as healthy and happy with a lot of carbonates in the water. You will know you have high carbonates by looking at your faucets. If there is a bit of a white build-up, that is a sign your water has high mineral content.

If this is what you are seeing or if you have tested the water and it is indeed high in minerals, you need to find an alternate water source. Yes, you will either need to buy water or consider setting up a couple of rain barrels to catch water from the sky. Rainwater will not have minerals in it. It has also not been treated with chemicals like most of the water you pull from the tap.

Rainwater is a great way to start your tanks off right. You can set up a catchment system that captures the rainwater from the roof of your home. This water is used to top off your tanks. However, with a rain catchment system, you need to be conscientious of bird poop. Birds will poop on the roof and it will drain into the gutters. Your rain catchment system is going to catch all the poop as the water flows down the roof, into the gutter and ultimately into your barrel. To ensure you don't get sick, always wash the fruits and vegetables you harvest to ensure your health and safety.

While you are picking up IBC barrels for your aquaponics, grab an extra one or two to use for rain catchment systems.

Now, if you don't want to use rain barrels or they are not legal in your area, you can go another route. It is much more expensive. A filter designed to remove those minerals from your water will run you about \$300 or more. RO filters can be found online or in aquarium stores. You can expect about 20 gallons of water to be filtered a day, which will be enough to replenish the water your system needs daily. This is a convenient option and means you don't have to worry about a drought and your system not having enough water.

Pumps

You are going to become very familiar with the world of pumps as you develop your aquaponics system. Basically, there are two types you need to research—air and water pumps. These are going to help circulate your system and keep everything alive and healthy.

Water Pumps

There are two main types of water pumps. Submersible are pumps that are put into the water and in-line that are on the outside of the tank. Most people will start with the submersible pumps. As you get more familiar with things and you grow your system, in-line pumps are a better choice. In-line pumps are easier to clean and maintain and they are made to handle more water volume than the submersible pumps.

Another main difference between the two types is the way the pumps are kept cool to prevent overheating. Submersible pumps are generally kept cool simply by the water they are sitting in. In-line pumps are set outside the system and have a fan that pumps water through the lines and cools the motor at the same time.

In-line pumps are sensitive to water. If you have an accident and the in-line pump gets wet, it is going to fry it. They are a little risky to use with an aquatic system, but they are easier and can pump more water.

The trick is to just be really careful to keep your pump dry.

If you are handy, you may be able to use an old pump out of a dishwasher. This gives you a nice pump for a fraction of the price and it will tolerate water.

Check around online and do some research. Check forums and ask other aquaponics hobbyists what they use. When you are looking at pumps, you want to check on the amps it takes to run the pump and how much electricity it is going to be pulling. The amount of water the pump can move and the head height of a submersible pump all need to be considered when you are thinking about purchasing. The pump has to be right for your particular setup. Earlier we mentioned that the higher the height of the pump, the less volume it will move. Keep that in mind while you are shopping.

Air Pumps

Air pumps are not a requirement in all setups. They are generally used in systems that oxygen depletion is going to be an issue. If you were to stock the tanks really full with fish, then an air pump may be needed. For the particular set up covered here, there will be plenty of aeration and an air pump will not be necessary.

A venturi pump is an option if you are circulating a great deal of water. A lot of the submersible pumps sold through hydroponics stores will actually include a fitting to attach a venturi pump. A venturi pump will suck in air and then push it out with the outflow.

These pumps are a 2 for 1 deal and can add extra aeration just in case.

Large raft systems will require an air pump. You have a lot of choices here. You can go big with pumps that have several horsepower or go with a tiny pump that runs off an amp. So, while the pump may not be a necessity, they are inexpensive and easy to install if you do need one.

If you only have to lift your water a short distance, you can get a very energy-efficient air pump referred to as an airlift pump. Basically, there is a pipe. The pump blows a bubble into the pipe and lifts the water just a little ways.

Air pumps are great for lifting water a little, but they are just not going to be enough for higher head heights. If you want an air pump, go for it, but they are generally not a necessity.

Determining Depth of the Tank Beds

One of the first questions a new aquaponics user will have is asking how deep to make the tank beds. The question will garner various answers. Some will say 8 inches for a grow bed and others will say 14. The average tends to be about 12 inches deep for the grow beds. In this particular set up, the grow bed will be 8 inches deep.

For the fish tank, the depth is going to vary depending on you, your wants and what you have. A deep tank can be a bit problematic for a short person who needs to catch some fish. If you are a tall person, you don't want to be getting down on your knees to try and tend to a tank. You will want to make it a bit higher.

The type of fish you are going to stock will also factor into the depths of your tanks. Bottom dwellers will do best with shallow tanks so you can keep an eye on them. Don't get carried away and make the tanks so shallow you lose a lot of volume. This can happen easily when you are using IBC tanks. Do what you can to maintain volume by keeping a nice tank depth. Grow beds have a similar issue. If you make them too shallow, you are reducing your plant growth.

Increasing System Efficiency

Efficiency is a big deal when you want to conserve heat, water and electricity. There are 2 things you can do that are fairly easy and very effective at improving the efficiency of your system.

The first one is insulation. During the winter, you are going to be warming your tanks. The warmer water is going to evaporate more quickly.

You will be using electricity to heat the water and needing to replace more water. Insulate the building your system will be in to help keep it warmer. The warmer the building, the less heating you will need. Insulating your tanks will help them stay warmer and you won't have to heat the water as much.

The second thing you can do is to put your pumps on a timer. You don't need the water to constantly be moving. You can save electricity by only having the pump run for a certain period of time at regular intervals. The fish will be happy and your plants will be just fine.

The pump timer solution is best used with submersible pumps only. They won't need any priming and can handle being shut off and on. They also use very little electricity to start so you aren't pulling a big draw at the beginning of each start up.

Every little bit helps. Do what you can to make your system more energy efficient so you are not driving up the electric bill and defeating the purpose of being self-sustainable.

More About Water Quality

Water quality is everything so it deserves another section dedicated to making sure you get it and understand all the elements that make the water perfect. It is very important you get off on the right foot and that is done by starting with the right water from the very get go. Rain water or filtered water is your best option. You need to cycle the system to get all the chlorine and choramines out before it is time to introduce your fish.

Cycling the System

Earlier it was mentioned your system will need to cycle for about 6 weeks before it will be ready for you to start adding fish. Before you get the cycle going, you will need to monitor the sitting water temperature. This will help you determine what fish will do best in your aquaponics system. The temperatures should be taken before you start the pumps and the circulation.

Dissolved Oxygen Levels

This isn't something you can really fix any other way than keeping good circulation. The oxygen in the water is essential to the health of the fish. The fish need oxygen to live and your plants will need the oxygen as well. Without a good dissolved oxygen level in the tank, things will die. The way to keep the levels up is to keep the water circulating.

Splashing water is a good thing. Lots of surface area for the water increases the amount of oxygen in the tank. You don't want the tank covered with no surface area exposure.

The water that cycles out of your grow bed is going to be high in oxygen. The water going into the grow bed will be a bit lower. Keeping the water temperature low is also going to help. You don't want the water getting too warm. If it is a hot, sunny day, shade the tanks to keep the water cool. The warmer the water, the lower the dissolved oxygen levels.

In areas where it is really warm, you may see fish at the top of the water, gasping for air. There is so little oxygen in the water, they are coming to the surface to try and breathe. You need to keep the water temperature down to allow for plenty of oxygen in the water.

Keeping pH in Check

This is going to require you to test regularly and test often. You want to aim for a number between 5 and 6. At startup, your pH levels will be a little on the high side and this is okay. As things start to circulate and your nitrifying bacteria has time to work, it will begin to drop. If the pH levels don't start dropping, you likely have too many carbonates in your system. Your plants will suffer and you won't get that happy medium you are going for. Reduce the carbonates and let biology do the work.

Now, you don't want the pH to drop into the low 5s. That is too low and you will need to work to increase it. This needs to be done slowly. Dramatic, rapid changes will cause ammonia spikes and your nitrifying bacteria are not going to be happy. The high ammonia levels will result in fish dying. If you can keep your dissolved oxygen levels high, you can keep your pH around 6.5 and 7.4. The ammonia levels should be under 1 ppm.

At the initial startup phase, without fish in the tank, the ammonia level will be higher than 1ppm. That is okay. It will come down as the cycle starts to do the work. If the levels go up, that means your nitrifying bacteria have slackened off or died. You may also be over feeding after you introduce fish. It is all about closely monitoring the levels and catching problems early.

When you think about your aquaponics in a survival setting, you have to think about drinking that water. You certainly don't want to drink water with high ammonia levels. High nitrogen levels are not going to be good either. Decaying or dead fish or plants floating in the water is certainly not ideal either. Keep the oxygen high, the ammonia low and things will maintain a nice, harmonious balance.

Fish Food Options

There is no shortage of fish food options. There are all kinds and there are plenty of brands. Ideally, you want to choose a feed that your fish will actually eat. You don't want the fish to ignore the food and you end up with high ammonia levels.

Only buy quality brands of feed, even if they do cost a little more. One brand that has done really well for a lot of hobbyists is Silver Cup. The fish seem to like it and will eat it up.

You also want to pay attention to the amount of protein in the feed. Higher protein feeds will lead to a higher nitrogen level in the tank. You want to choose the feed based on the fish you will be putting in your tank.

If you are going with fish that need a high-protein diet, then that is the kind of feed you need to go with. Crude fat, fat and filler content is also important to look at. Choose a food that is going to satisfy all your fish's needs while ensuring they are nice and healthy.

Feather Mill sells a feed that has protein content, but it isn't actually protein. The fish cannot digest the protein and it ends up dirtying up your water. Avoid anything like that.

It makes sense to stock up on feed, especially if you are planning to use it after a collapse. However, feed doesn't store for long periods of time very

well. You must ensure it is stored somewhere cool and dry in order for it to last as long as possible. Avoid putting the feed anywhere it is going to be exposed to direct sunlight as well. The oils in the feed can go rancid. You will also have to protect the feed from rodents and other pests.

If you run out of feed, there are some supplements you can find that will keep your fish fed. However, these foods are not quite as perfect as feed designed for fish. The fish will still eat and thrive, but they won't grow quite as fast.

Fish Food Supplements

Fish love to eat bugs. There is generally not a shortage of bugs around. The key is to capture them or create a system that the bugs will essentially drop into the tank.

One way to do this is by hanging a bug zapper over the tank. It is obviously very important you secure the zapper so there is no chance it can fall into your tank and you don't want any water being splashed onto the zapper. The bugs will hit the zapper and drop into the tank.

Hanging road kill or carrion in potato bags over the tank is one way to have a large supply of maggots. The maggots will hatch and fall into the tank. This is not the most appealing set up and it can get stinky, but it is a lot of extra protein for the fish.



Black Soldier Fly

The black soldier fly is yet another option. The flies lay their eggs in compost or any decaying material. The eggs can be fed to the fish. The larvae are incredibly high in fat and protein. It is best if you serve the fish something mixed in with the larvae to avoid them getting too much fat and protein.

The plants mentioned earlier, duckweed and water hyacinth are also great, renewable options. For tilapia, you can add the waste from breweries if you can get your hands on in. Alfalfa pellets are also an option.

Research the fish you will be using and learn about what they eat. You can likely find supplements in your environment. Keep in mind, supplements may not always be available, especially in the middle of winter. You will have to get creative.

Identifying Nutrient Deficiencies

Your plants are a big part of your aquaponics system. After you have planted seeds and you see the sprouts, you will want to pay attention to the color of the plants and any signs they are not thriving as they should be.

A nutrient deficiency can stunt a plant's growth, promote bacteria or kill the plant altogether. Basically, a deficiency means the plant isn't getting what it needs to thrive.

Plants that have foliage that is a bit anemic looking, like a light yellow or super light green are usually chlorotic. The leaves may yellow and turn brown at the tips. These are all signs the plant is missing some key nutrient.

Most of the time, the nutrient that is low or missing is either going to be magnesium, iron or potassium. Earlier we mentioned what to add to supplements these nutrients. Keep that handy so you can take care of any problems quickly.

The main nutrient supplements you are going to want to keep on hand are as follow;

- Potassium hydroxide (caustic lye)
- Calcium hydroxide (agricultural lime)
- Chelated Iron

- Epsom salt
- Potassium chloride

When adding nutrients to the water, you don't want to completely throw off the system. It is a fine balance. A little will go a long way. Potassium hydroxide or caustic lye are pretty commonly used to help balance out the nutrient levels in the water. You don't want to go overboard with these. You will want to monitor the pH levels to make sure there are not any big fluctuations after you have added a nutrient supplement.

In many cases, the lack of potassium can be blamed on the water used to fill the tanks. If the water has a high calcium level, the potassium can't compete.

The two minerals are very similar and the potassium will often turn into a solid that the roots of the plant cannot absorb. You may test the water and see you have plenty of potassium, but if you notice you have high calcium levels, you will understand what is happening.

Chelated iron is great to have on hand to help out wilting plants. The chelated iron can maintain, even at high pH. It attaches itself to a special molecule and the plants will absorb it fairly easily. Epsom salt is a quick and effective way to add magnesium to the water.

If your system has a high pH, but you need to add nutrients, avoid using potassium hydroxide that may increase the pH and go with potassium chloride. This is a common substance used to melt ice.

In most cases, your deficiencies will be very mild. You are not going to need to dump buckets of nutrients in. Think of it as seasoning a meal. A little is all that is needed.

There are plenty of tricks and things to know about nutrients and some of the deficiencies that can occur. It is easier to research problems as they arise rather than put everything out there and you have to sift through and try to diagnose the issue.

Managing Insect Problems

Fish like most insects, but your plants need to be kept relatively insect free. This means there will be a fine balance. Using insecticides can cause a lot of problems for your fish. They are very sensitive to the chemicals used to keep insects away.

There are some safer, alternative methods to insecticides.

Aciduractin-This is a relatively safe product and is the active ingredient in Neem, which is derived from a plant.

Neem Oil-As you can guess, it is oil derived from the neem tree.

Botanigard-This is a fungal spore that will kill the insects, but not fish or the plant.

Pyrethrin Soap-This is another natural soap that kills the insects.

Each of these are relatively safe, but you don't want to get carried away. Anything that goes into the tank is going to have some effect on the fish.

Anything with pyrethrins is going to be very toxic to insects as well as your fish. It is best to only use the soap if you are using troughs or ZipGrow towers that will keep the soap out of your tank.

One remedy that is also effective is using beneficial insects that prey on the pesky insects. Ladybugs are wonderful additions to your aquaponics garden. Aphidius wasps and green lacewings are also beneficial insects.

These beneficial bugs will work best if you have a greenhouse or other enclosed space that keeps them hanging out in your aquaponics system. They will leave if they can. Your neighbors may appreciate the gift of beneficial insects.

Do what you can to organically control insects. Have your insect control supplies on hand before you ever get started. This way you can take immediate action and not wait days for your solution to be delivered.

Starting Your System

You must cycle your system before you really get started. Cycling is the process that allows the beneficial bacteria to grow before you add fish or plants. This has been talked about throughout the book. It is extremely important to the success of your system.

You have to have the nitrifying bacteria in place and working before you ever add fish. If you put the fish in and there is no bacteria to clean the ammonia, they will die.

Get your system going and then add a little household ammonia. You only want to add about 1 or 2ppm. Over a period of about 14 days, you want to test the water and monitor the ammonia levels. If the ammonia decreases and the nitrite increases you are on the right track. Within a couple of weeks, the nitrite level will go down and the nitrate levels will increase. Test your system by adding ammonia and see how long it takes for it to be processed and removed. It should take about 6 to 7 weeks for your system to cycle and be ready for fish.

Now, some people don't want to use ammonia so they get creative. These are not recommended methods, but they have been used. One is to add human urine into the tank. Technically, that is a good test, but you will be dealing with the smell of pee. Your fish will be swimming in water that had pee in it and your plants will be absorbing the pee water. Yes, it is safe, but it is just something you need to be okay with.

Another option is to add a dead fish to the water and wait. This is risky because you could be introducing disease to the tank before you ever get started. Adding inoculants like we mentioned earlier is a method the impatient people use. Yes, it gets the cycling jump started, but it isn't always best.

Do what you can to have patience. Wait it out and your system will be healthier for it. Test your system with some feeder goldfish once you have waited and think your system is ready. This is an inexpensive way to give your system a trial run and identify any problems. You don't want to buy fish that may die right out of the gate. Your system may have all the right levels of nitrates and ammonia, but any small detail could throw it off and the fish will die. It is best to find out before you invest money in fingerlings. Fortunately, once your nitrifying bacteria are in place, they are not easy to kill. Just don't expose them to that UV light we talked about earlier. You can buy a ZipGrow tower that already has all the bacteria it needs and set it up to get started right away.

Test, Test, Test

The success of your system is going to greatly depend on your water quality. The only way you will know what that quality is, is by performing regular tests. You will want to purchase a number of test kits that will tell you everything you need to know. You can't see ammonia in your water. You need a kit to tell you how much there is so you can take action.

You want to get in the habit of testing your water each day. Ammonia and pH can change daily, especially once you have fish in the system. When you are cycling your system, you have to test daily to determine if it is going in the right direction and when it is ready for fish. Don't stop testing once the cycling is complete.

Let the cycling run its course. Yes, it can be very difficult when you are anxious to get started, but jumping the gun is going to cost you money. Your fish will die and you will have to start over. If you happen to have access to media from an established system, you can introduce that to help speed things up a bit. Make sure the tank you are pulling from is healthy. You don't want to introduce disease into your clean tank. You could also pull some water from that established tank to kickstart your own.

You will learn, but ultimately, patience will be your best friend when you are first starting your aquaponics tanks.

Maintaining Your System

As with everything in life, maintenance is the key to longevity and productivity. When you are building your system, keep in mind the maintenance aspect. The bigger the system, the more maintenance it will require.

You also need to think about how you will access each element.

For the system that we will build in this book, it is fairly low maintenance. Fortunately, as time goes on, the maintenance of your water and things like that gets easier.

Once things are established, it pretty much runs itself. If you have a lot of fish and it is dense, things are going to be trickier and the maintenance will be more.

There are just some basic routines you want to get into.

Everyday you want to check the following;

- Check the temperature of the water
- Check the ammonia levels
- Check the pH level
- Watch your fish to make sure they are swimming and eating well
- Check your plants to make sure there isn't any insect infestations
- Check for any leaks in the tank
- Check to make sure there are no dead fish in the tank
- Look at the leaves of the plants to make sure they are a healthy green color
- Make sure there are no overflowing tanks

This may seem like a long list of things to do everyday, but once you get into the swing of things, it only takes a couple of minutes to quickly check things over.

Now, there are some things you will want to do on a weekly basis. Give your pump a good inspection and clean it if necessary. Check all your pipes and make sure there are no leaks around the fittings and they are in good shape. Spend a few extra minutes evaluating the plants and determining if there are any nutrient deficiencies that will require you adding one of the things mentioned earlier.

Monthly inspections should include a good look at the media bed. If you notice there seems to be a layer of sludge, you can use a siphon to remove the sludge. You don't want things to clog up. You will need to adjust feeding if you notice there is quite a bit of sludge in the tank. Once a year, you need to give the media a thorough cleaning.

Harvesting the Food

This is why you are doing aquaponics. You are creating a renewable food source. Harvesting is something that needs to be done on a schedule so you are not pulling everything at once. You need to harvest in order to clear out the old and make room for the new. Old plants invite disease and insects. When their time has come, they need to be removed.

Harvesting Vegetables

With most vegetables, when it is time to harvest, you want to remove the entire plant, roots and all. With leaf crops, like kale and lettuce, you can leave the plant and just harvest the outer leaves of the plant. It will continue to grow and produce new leaves for several weeks. Expect to start harvesting leaf crops in about 6 weeks.

Once you have harvested a plant, compost the parts you don't eat as well as the roots. Plants like cucumber, tomato and zucchini can be harvest over time. The fruits will mature at different rates over a period of weeks.

Pay attention to the health of your plants. If a plant develops powdery mildew, which is identified by a white powder substance on the leaves, pull the entire plant before it can spread to the rest of your system. This applies to any disease or serious insect infection. Pull the entire plant out and start over.

If you have a plant that is much bigger than the rest and hogging all the light, it needs to be removed. It is better to have lots of plants rather than just one healthy plant.

The goal with harvesting is to get to a point where you can harvest a little food every few days. You don't want to go weeks at a time between harvests. In a survival situation, you would starve during these barren periods.

Harvesting Fish

You want to harvest fish in a similar manner as your vegetables. Fish need to be harvested regularly to thin the pack and make room for more. It is important you pay close attention to the fish and their behaviors. If you see a fish hugging the bottom or floating on its side, pull it out of the tank. It is likely sick and you don't want to risk your entire crop being infected.

Fish that are overly large will begin to eat your younger, smaller fish.

They need to be harvested before they deplete the younger fish. You need to establish a cycle that constantly keeps new fish being grown and replenishing with younger fish.

In this particular setup, you will be harvesting fish every couple of months. If you were to build a bigger system, you could increase harvest times to weekly or whatever your system allows. You will start to get the hang of things and know when it is time to harvest the fish to keep the system thriving.

Fish reproduction is a bit slow simply because the water temperatures and other breeding factors. Once you have your system established, you can get that breeding tank going and begin to increase the reproduction.

It is important you start out slow on the harvesting, especially in a small setup. Taking too many fish out of the tank at once will upset your balance. If you have huge tanks, this won't have quite the same effect. Start slow and see what your system can handle. With time and experience, you will develop a pretty good idea of when and how much to harvest at a time.

Building an IBC Aquaponics System

Alright! This is what you have been waiting for. Grab your tools and supplies and let's get started! The IBC containers are perfect for the beginner. They usually come with a steel frame that makes them easy to move and makes them a bit more stable. They can hold about 285 gallons of water on average, which makes them a nice size, not too small and not too big.

For this particular setup, you are going to be slightly limited because the grow bed is going to be rather small. That means you don't want to overstock the tank. Think of this as a stepping stone. You can make your system bigger and add on more components as time and experience allows.

This setup will not be a sump one. The pump will actually be in the tank with the fish. The actual container will be the sump. The pump will move the water up to the grow bed. You can certainly change things down the road and bring your grow beds down to ground level if your sump is in the ground. That is for another time.

Getting Your IBC Ready

Hopefully you already have your IBC and are ready to go. You will need to find a socket that fits the bars that run across the top of the container. Remove the secures that are securing the bars. Put the screws somewhere

safe. Turn the cage on its side and pull out the plastic liner.

Stand the IBC up and grab your tape measure and the marker. You will also want a level or some kind of measuring stick. Measure 9 inches from the top of the container. Make a line all the way around, 9 inches down.

Use a circular saw, reciprocating saw or a sawzall and start cutting along that line. Do your best to cut a fairly straight line.

Once you get to cutting, watch for the small burs on the plastic. They tend to be sharp and can cut you.

Once you have cut completely around the top, the piece should come off fairly easily. Set it aside.

Cleaning the Tank

Now it is time to get in there and give the tank a thorough cleaning. You want to make sure you get every inch inside that container.

Baking soda or vinegar, depending what was in the tank, are great to start with. Then use standard dish soap and a sponge to clean the inside.

Spend some time here. Any residue in the tank could completely throw off your cycling and cause you major problems down the road.

Wash the tank several times until you are convinced it is clean. Smell the tank to see if there are any lingering odors that would indicate it is still dirty.

Making the Tank Beds

Now, you are going to need your sawzall with a metal blade. It is time to cut the bottom off of the metal frame the plastic liner was in. You want to make the cut above the bottom bar that runs along the side of the tank. This should be several inches high. Cut all the metal bars so the bottom of the metal frame comes away cleanly and creates a nice, short frame on its own.

The original frame will be minus the top and bottom at this point and just be an outer frame. You can use a file or a grinder to smooth out the ends of the metal to make it a little safer. The jagged edges can be a hazard.

Now, you will have the bottom portion of the metal frame and the top half of the plastic liner. The liner is going to fit right into that metal frame. This will be your grow bed.

Plumbing the Tank

We need to add the pipes that will push water into the upper grow bed and plumbing that will allow the water from the grow bed to go back into the fish tank. These are going to be different jobs.

The grow bed is going to be sitting on top of your fish tank. It will be staggered so you can still see into the fish tank. The grow bed will be slightly overhanging with about 18 inches of free space between the edge of the grow bed and the edge of the tank so you can see the fish.

The inflow and the outflow are the key components of your plumbing. The inflow to the grow bed and the outflow is the grow bed into the fish tank.

Grow Bed

We will start with the plumbing for the grow bed. In the center of the liner, there is a hole with a lid. This is where you would normally fill the tank if you were using it as intended. The lid should be thoroughly cleaned. Put the lid back into place and make sure it is nice and snug.

In the center of the lid, use the 2 ¼ inch bit on your hole saw and make a hole. Insert the threaded fitting into that hole. Be careful you don't force it. It can tear. The fit should be snug. Screw the male fitting down into the hole.

If it is too tight, you can use your blow dryer to heat the plastic and make it a little more pliable. Don't get the plastic too hot. You need this to be snug, but you don't want to tear the plastic by forcing it.

At this point, the fitting will be in the air. When it comes time to put the grow bed over the tank, it will be pointing into the tank. Wrap the end with Teflon tape and then attach the female fitting to the male fitting that is in the lid. Make it tight, but don't get carried away. This particular joint isn't going to undergo a lot of stress.

Your goal is to make sure it has a good seal and doesn't leak overly much.

Now, add a 2-foot piece of PVC pipe. You can adjust the length based on personal preference. The longer the pipe, the less splashing and aeration. The shorter the pipe, more splashing and more aeration. Insert the pipe into the fitting so that when the grow bed is flipped over, the pipe will be directed down into the fish tank.

Take an 8-inch piece of PVC and use a spade bit to make numerous holes up and down the pipe. This is going to act as a drainage pipe that goes from your grow bed into the long PVC pipe and into the fish tank. This small pipe is going to stick up into the grow bed on the opposite side of the lid. So, you will have the pipe with holes connected to the fitting in the center of the lid in your grow bed.

If your pump is going to be on a timer, you will want about 10 holes. If it is going to be constantly running, 6 holes should be enough. The timer will run the pump, which will fill the grow bed. The drainage pipe will allow the water to slowly drain back into the fish tank. Start out with a few holes and you can always adjust it down the road.

You don't need to glue this pipe into place. Simply slide it into the fitting.

Fish Tank

Cut a 2x4 in half to lay across the top of the tank. This will be creating a frame for your grow bed to sit on. Place one of the halves across the back edge where the bed will sit and another about two thirds over the tank to

support the edge of the grow bed.

Put the grow bed in place over the fish tank. Add a small layer of the media you have chosen. We will assume you are going with the crushed granite.

Grab a piece of your 4-inch round PVC. Assuming the crushed granite is $\frac{3}{4}$ inches big, you want to make numerous holes in the PVC that are about $\frac{1}{2}$ inch around. This larger piece of PVC is going to slide over that stand pipe you just put into the center of the grow bed.

The big piece of PVC is going to be your screen to keep the drainage pipe from getting plugged. The holes in your outer screen need to be smaller than the media you are using otherwise the media will go right through and clog around your center drain pipe.

Place some more gravel around the pipe to hold it in place. DO NOT add any more gravel at this point.

Setting up the Inflow

Now it is time to install the pump that will push the water up into the grow bed. The pumps are usually equipped with a suction cup that holds them in place on the bottom of the tank. Place the pump on a side that you can easily get to, even after your system is up and running.

The pump will have a $\frac{3}{4}$ inch barbed fitting that is meant to be attached to $\frac{3}{4}$ poly pipe. Use your heat gun or blow dryer and warm up the end of the pipe.

When it is pliable, slide it over the barbed fitting. Extend the pipe to the top of the tank and cut it. Insert a barbed L fitting into the pipe.

Heat the end of the pipe again and attach it to the other end of the L fitting.

The pipe should be hanging out over the edge of the fish tank.

Cut the pipe and add another L fitting, heating the piping to slide it over the barbed fitting.

The L should be pointing up, towards the grow bed. Attach more tubing just long enough that it touches the bottom of the grow bed.

Attach the third barbed L fitting to the top of the pipe. The L should be pointing towards the center of the grow bed.

Attach another piece of poly pipe to the L. This piece should be 2 to 3 inches long depending on how close to the edge of the bottom tank you ran the piping.

Now, grab the $\frac{3}{4}$ inch to 1 inch threaded fitting. Heat up the poly tubing and slide it on. Wrap the threaded end of the fitting with Teflon tape. Attach this end to the female portion of the fitting.

Inflow 2

Once the barbed fitting is wrapped with the Teflon, grab your PVC T. The T should be a 1 inch to $\frac{3}{4}$ inch fitting. The T is going to be screwed onto the threaded portion of the $\frac{3}{4}$ to 1 inch fitting. You don't have to make it super tight. The Teflon tape should take care of any leaks. As of now, you have the pipe into the grow bed that leads to the PVC T.

With your grow bed on the 2x4 braces, it is supported enough to add the rest of your media to the bed. You will want about 8 inches of gravel so it is just about an inch below the edge of the grow bed liner. You should have your inflow pipe on the side and your drainage pipe in the middle of the grow bed.

Now, you will need to get your PVC pipe. Cut it so that when you stick it in either side of the T in the grow bed, it will reach the edge of the bed. Insert the pipes into the T. You don't have to glue it. Any water that leaks is just going to go right into the bed.

Add a 1-inch L to each end of the PVC pipe so that it is directed to the outer edge of the pipe. Cut more pipe to extend the length of the bed to the next corner. You are creating a PVC perimeter around your grow bed. Insert the pipes as before. Add Ls to the ends of these pipes. Connect the pipes with a pipe that connects the whole thing. You should have a nice square of connected PVC pipes.

Take out the pipes and drill a few small holes along one side of each pipe. Put the pipes back in place, with the holes facing down into the grow bed. This way, when the water is pumped in through that pipe on the side and into the T, it is going to go through the pipes around the perimeter. This will give your grow bed nice and even watering throughout.

Hopefully, you have already rinsed your gravel, if not, you need to do it now. It doesn't hurt to give washed gravel a good rinsing again. Use a water hose and run it all over the top of your media. Keep doing this until the water coming through the drainage pipe and into the tank is nice and clear. Open the drain valve in the bottom of your large fish tank to let the rinse water flow out.

Grab that 8 inch PVC pipe we cut earlier and stick it into the fitting in the lid of the grow tank on the bottom side. The pipe will be pointing into the fish tank.

At this point you are ready to start the filling process. Close the drain valve in the bottom tank. Fill up your fish tank with water. Plug in your pump and let it start to work. Watch to make sure it is functioning as it should.

The pump should be pushing water into your grow bed. Water should be trickling through the pipes around the perimeter. Water from the grow bed should be dropping into the fish tank making some splashes. Splashing means aeration.

Growing Duckweed

Duckweed is another perk to having your own Aquaponics system. It is pretty easy to grow and can be used in a number of ways. One of the main reasons you will want to have duckweed is its ability to remove nutrients from the water. If you are looking for a natural way to control ammonia levels in your water, duckweed is the answer.

Duckweed has an extremely fast growth rate. In fact, it can double in mass about every 24 to 48 hours if the conditions are just right. This can produce enough feed for chickens and fish for most of the year.

Duckweed has about 35 to 40 percent more protein than soybeans and a higher concentration of essential amino acids like methionine and lysine than the majority of plant proteins. This is very good news for your backyard chickens and their egg production. The trace minerals also make it a very good additive to any animal feed. Although it is important to note that only dried duckweed can be used as feed. The drying process is where this plant gets all of its protein and sustenance characteristics.

Duckweed is too easy, inexpensive and valuable NOT to grow in your garden. It is incredibly easy to grow and requires very little work on your part.

You will want to purchase your initial supply at your local aquarium shop. You can grow it in any open water vessel. A backyard pond, a fish tank or a large tub will all work. You will want to place smaller vessels in the shade to keep the water from becoming too hot.

It helps if you recirculate the water from your fish tank. This will save you the effort of scooping the water from your tank as well as ensure the nutrient levels in your duckweed container are level and ideal for growth.

Your duckweed should cover the entire water surface. If the cover is too thin, you risk algae blooming below it. Too thick and it will self mulch. Self-mulching will result in a lower production level. If the water is fast moving or if the container is placed where it is exposed to high wind, you will experience the same issue. Keeping a good cover will also prevent the water from evaporating quickly. You can add a few goldfish to your pond to help eliminate or at least keep the mosquito population to a minimum.

Feeding the duckweed can be done with a variety of organic materials. However, aquaponics is your best, free source. The duckweed will thrive on the unionized ammonia in the water of the aquaponics system. It prefers trace elements of nutrients and not large doses.

Another aspect to proper duckweed growth is to make sure the plant has enough nutrients. Duckweed that has long roots is not going to have the same protein level. You will also run into this problem if you keep the same strain of duckweed too long. Inbreeding will result in a lower crude protein level.

Temperature

Temperature plays a big role in the production levels of duckweed. It can't be too hot or too cold. Temperatures above 91 degrees Fahrenheit result in the plant dying off. Optimal temperature range is between 64 and 75 degrees. However, it can grow in temperatures as low as 42 degrees.

pH

The duckweed will grow in pH levels between 5 and 9, but ideally, you want to aim for 6.5 to 7.5. This is actually perfect, because this is the same level you want in your aquaponics system.

Blending Aquaponics With Soil-Based Gardening

Are you one of those people who really like getting your hands dirty in the garden, but really like the idea of raising your own fish? Do you really enjoy eating root vegetables that you can not grow with a hydroponics type system? You can have the best of both worlds by marrying the two ideas.

You should consider trying adding an aquaculture system to your soil-based garden in order to get the benefits of each system. As you may have noticed, Aquaponics is not going to work with root-based crops. That doesn't mean you cannot still use the nutrient-rich water from an Aquaponics system to water your root crops in a soil-based garden.

Your plants will thrive on the chlorine-free water that comes from your hydroponics system. You are saving water, by using it to grow fish (food) as well as watering your garden. And, you won't have to spend money buying fertilizers because your plants are getting the nutrients they need via the water. Now, if you have researched Aquaponics, you know there are some who are not excited about where the nitrate-rich water is dumped after it has circulated through the plant system. Some environmental agencies feel the nitrates are not healthy for the ground or sewer system.

However, you can eliminate the debate by using the water to feed your soil-based plants. It is truly an answer to the problem and gives everybody the chance to get the best of both worlds.

Alternative Systems: The Autopot System

Jim Fah created something that is known as the Smart Valve. The valve is part of the Autopot system that essentially regulates the amount of water that you give plants to your plants. Plants are placed into a tray. The smart valve fills the tray with a preset amount of water.

Once all of the water is soaked up by the plants, the smart valve will allow more water into the tray. This is a great idea to help plants that need more water, like a tomato plant in bloom, to get the water they need while preventing another plant from getting too much water. Jim Fah has taken his idea and perfected it. In his aquaponics setup, he has 1500 plants in Autopots.

The plants are fed with water from a fish tank. In the winter, they receive 1000 liters of water and in the summer, they require 2000 liters. Fish are grown in the tank, but because the water is constantly being circulated, there is no risk of ammonia concentrates becoming too much. Since he doesn't have to worry about ammonia, he doesn't need to mess around with bio filters, grow beds and regular water tests.

The plants are each fed the right amount of water filled with nutrients with the help of a pump as it moves the water from the tank into the Autopot units. Fah focuses his attention on his plants.

The fish that he grows are the extra perk versus many aquaponics users who focus on the fish and the output of the plants.

Conclusion

Setting up an aquaponics system in your own backyard is much easier than most people think. The actual building of the system is relatively simple. Yes, there seems to be a lot of information about how to keep the system running right and it can be intimidating, but in reality, it tends to work itself out.

Having a source of food for a survival situation makes good sense. You never have to worry about your family going hungry or being forced to eat processed foods that are not as nutritionally sound as fresh foods.

This book is designed to cover all the bases. You don't want to go in blind. You don't want to set up a couple of tanks and have everything die. This book is meant to explain the ins and outs and the reasoning behind every component in your aquaponics system. It is also meant to give you a very clear picture about what you can expect in terms of work and cost.

You can feel comfortable taking on this project and feel like you know more than the average aquaponics hobbyist. There is always more to learn and you will find you learn as you go. Good luck and get started growing your very own fish and vegetables!

Food For Freedom Quickstart Guide

For tanks

- IBC (International Bulk Container)
- Barrels
- Discarded bathtub
- Swimming pools Frames
- OSB
- Plywood Media and co.
- Gravel
- ¾-inch crushed granite.
- Expanded shale
- Hydroton
- Vermicompost
- Heirloom crops

Tools and co.

- EcoPlus Submersible pump
- Lightning systems
- Jiffy pellets
- Heat mats
- Mason jars
- 5 to 6 feet of ¾-inch black polyethylene tubing
- Three barbed ¾-inch L fittings.
- Three feet of 2-inch PVC pipe.
- One 2-inch female-threaded-to-female-slip coupling.

- One female-slip-to-male-threaded coupling
- One 10-inch piece of 4-inch or 6-inch PVC pipe
- One 3/4-inch L barbed-to-male-threaded fitting
- One T with a female-threaded fitting to slip on either side
- 15 feet of 1-inch PVC
- Four 1-inch L's slip-to-slip PVC couplings
- Teflon tape.
- Angle grinder with a cutting disk
- Reciprocating saw
- Jigsaw
- A permanent marker
- Tape measure
- A 1/2-inch drill bit
- A 2 1/4-inch hole saw
- A pipe cutter
- PVC pipe weld or PVC glue.
- Heat gun or blow dryer
- Safety goggles and gloves
- RO filter (optional) Nutrients & Supplements
- Calcium hydroxide
- Chelated iron
- Epsom salt
- Potassium chloride
- Agricultural lime
- Caustic lye

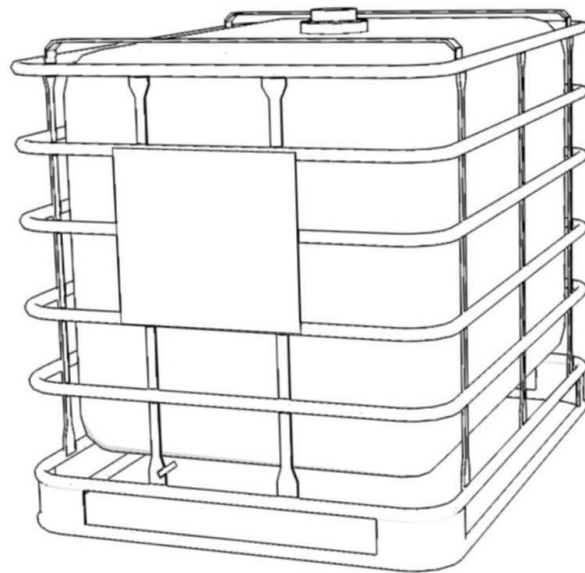
Fish

- Tilapia (White Tilapia, Blue Tilapia, Nile Tilapia)
- Common carp
- Channel Catfish
- Yellow perch
- Rainbow trout
- Bluegill
- Goldfish

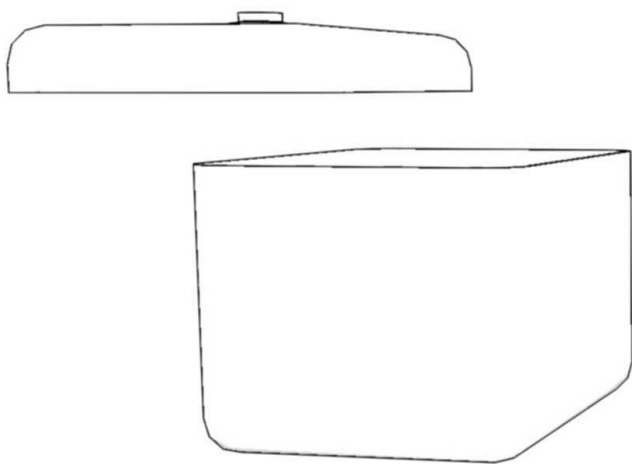
Additional plants & animals

- Seaweed extract
- Water hyacinth
- Duckweed
- Red worms
- Black soldier fly
- Heirloom crops

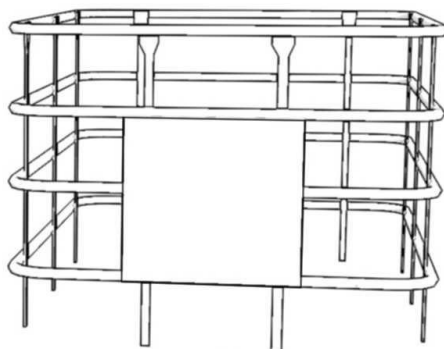
Diagrams For Food For Freedom Aquaponics System



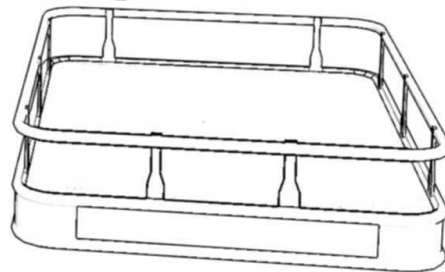
Removing top bars of the IBC



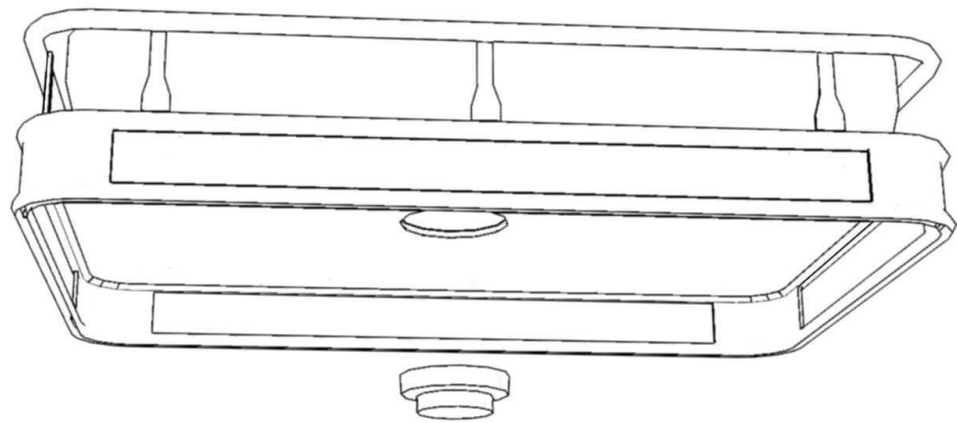
Cut the top of the IBC

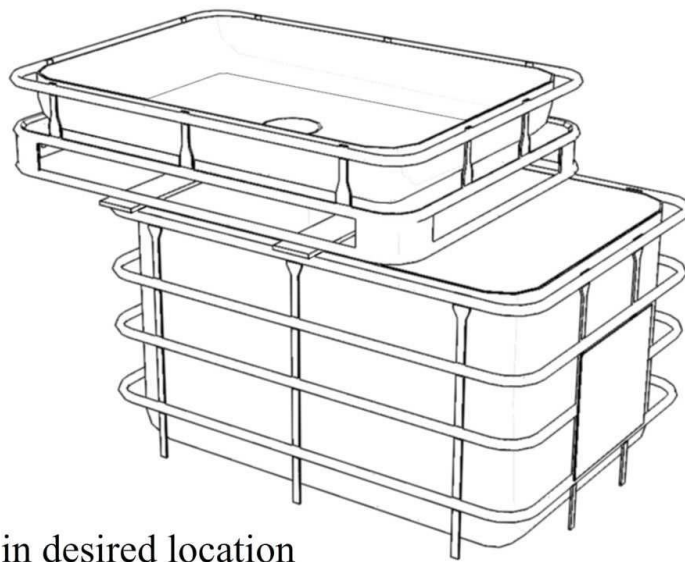


Cut above the first bar of IBC



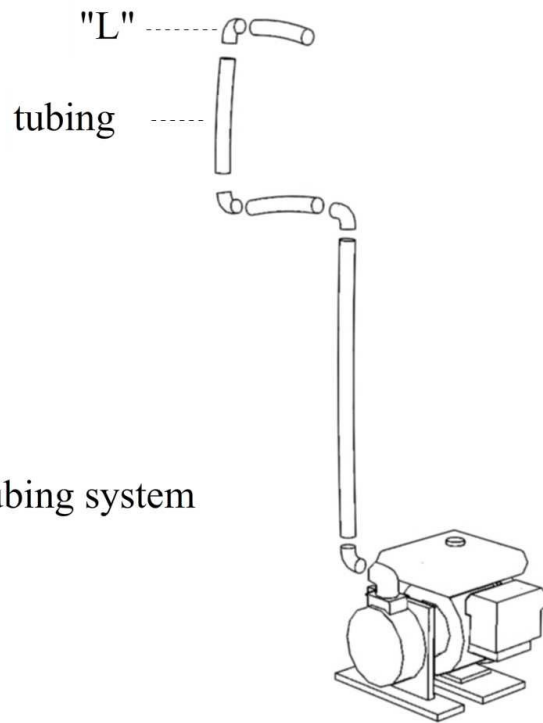
Cut drain pipe

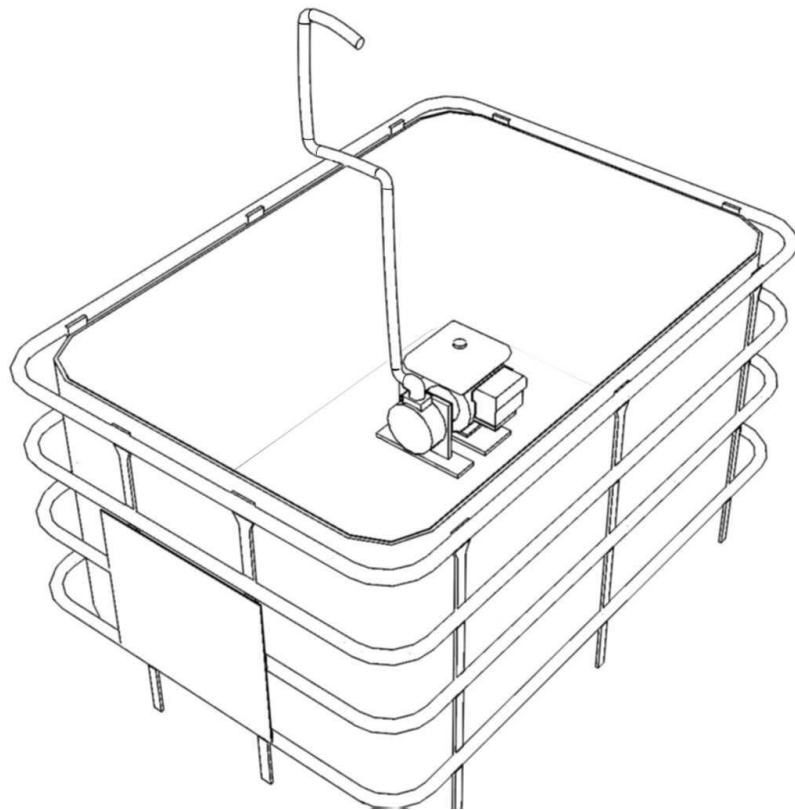


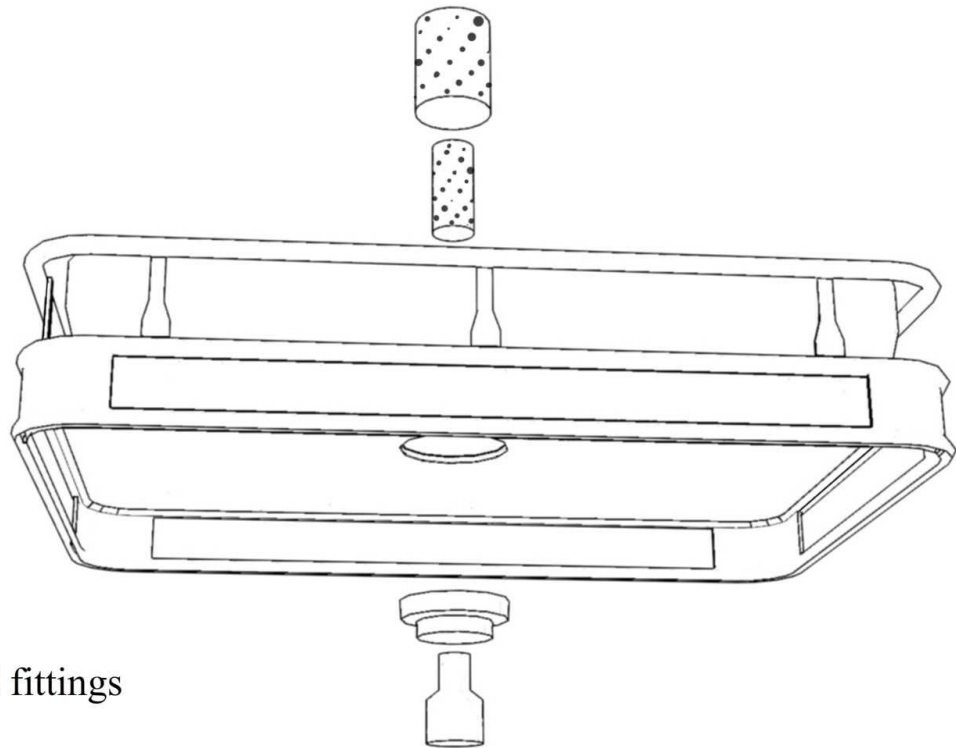


Place IBC in desired location

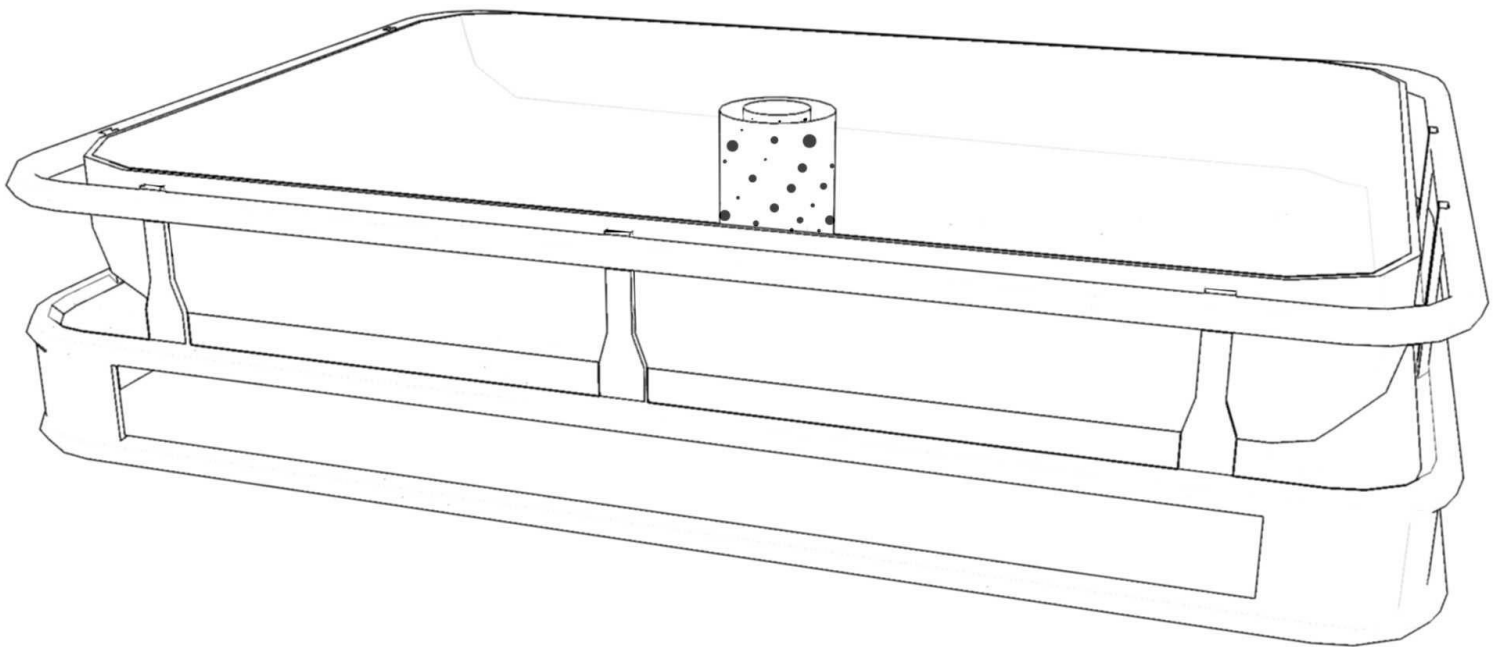
Install pump with tubing system

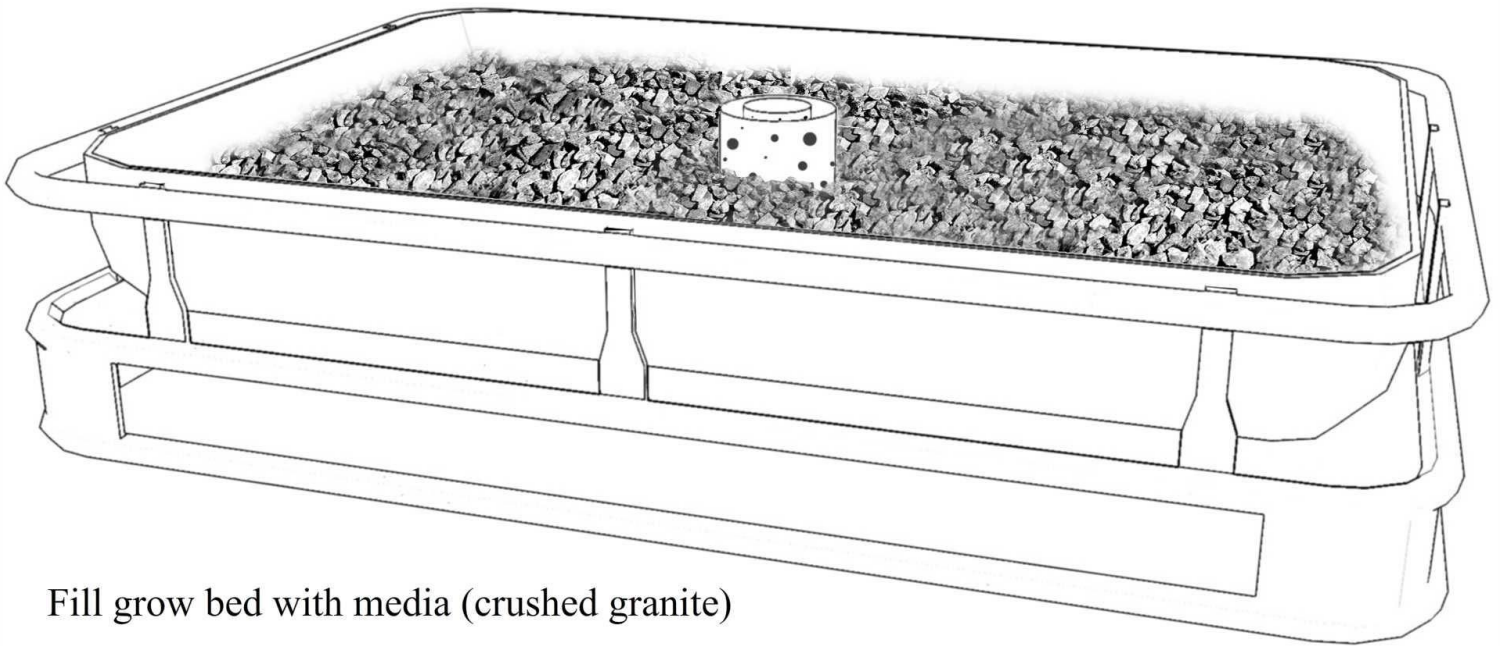




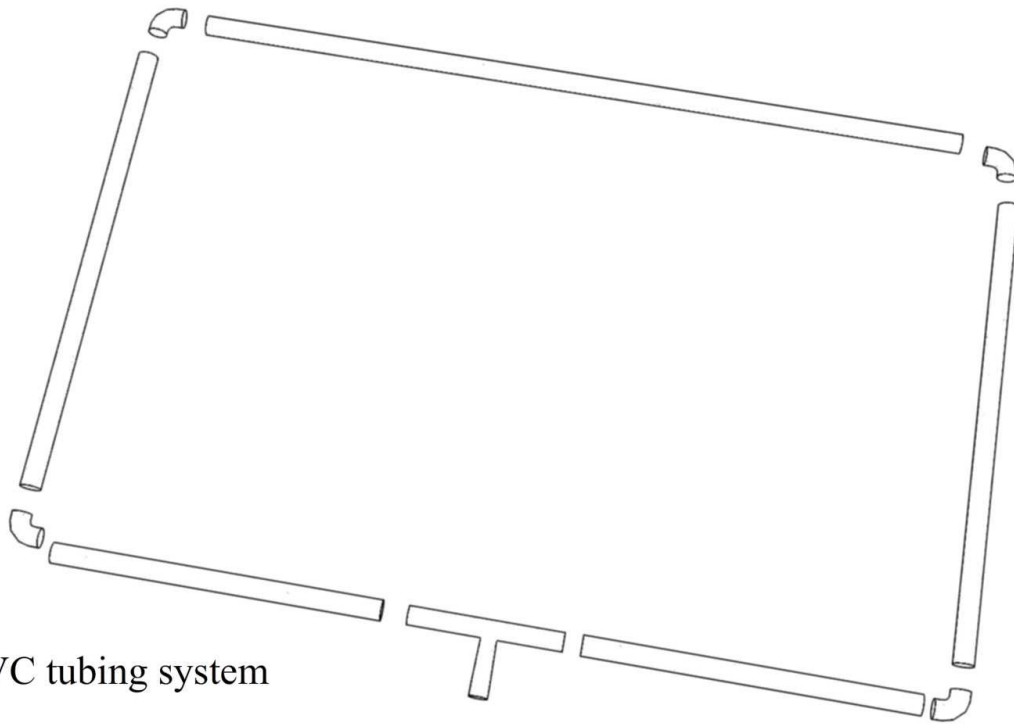


Connect PVC fittings

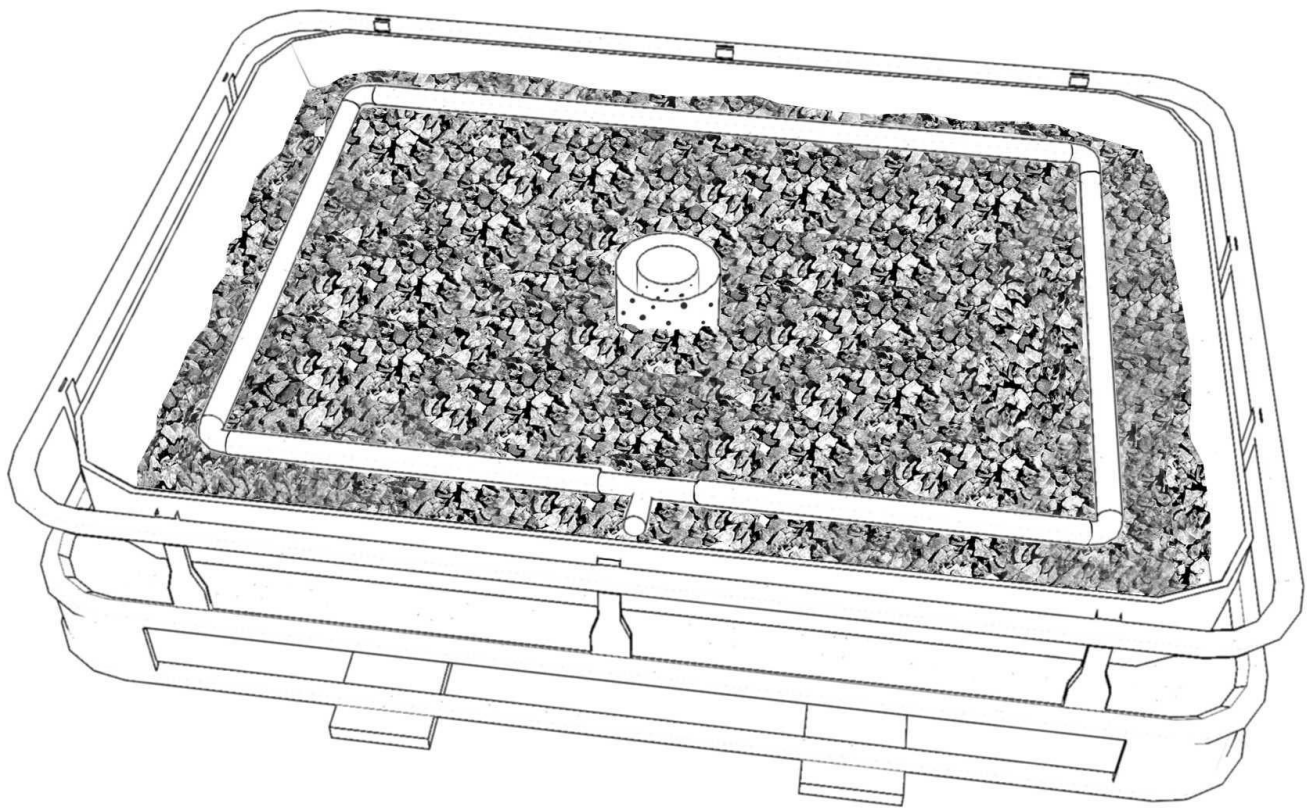




Fill grow bed with media (crushed granite)



Attach PVC tubing system





FOOD FOR FREEDOM

I would like to start this by saying “Thank you” for accepting *Food For Freedom* as your skilled & knowledgeable guide in all-things Aquaponics.

In a time when inflation has been causing food prices to increase at an alarming rate, you’ve made your first steps into providing your own food, in a healthier and more organic way...

You should be proud of this! As you start building and tending to your Aquaponics system, you will see that the fruits of your labor will certainly outnumber the hours of work you put in.

That I can guarantee you! So what are you still waiting for? Get down to business and begin a new, healthier chapter in your life!

Frank Tanner

Inside *Food For Freedom*, you will discover:

- *The Basics of the Aquaponics System*
- *How to Build Your Own Aquaponics From the Ground Up*
- *Harvesting*
- *Fortifying Your System*

And many more!

