

Zero-to-Hero!

System Construction Manual



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Welcome to Aquaponics



So, you're going to build an aquaponics system this weekend.

Presuming you've done your shopping already, if you do things right, in just a few days you'll have an aquaponics system. It sounds crazy, but if you follow the instructions you can do it. If you don't count drying time for caulk and paint, a group of us at the [Wisconsin Permaculture Convergence](#) built one in two hours.

In a month you'll add fish. In two months you'll start eating greens, and in 6 to 12 months (depending on which fish you raise) you'll be inviting your friends over for fish dinner.

Before you begin, you should know that you're embarking upon a journey. Building this system is a first step. Over time, you will find ways to improve it, try new fish and plants, and even add other creatures such as shrimp. You will also make mistakes that will kill fish and plants. As with all hobbies in which you care for living things, aquaponics takes a learning curve. The great advantage is that at the end of this curve you will have beautiful and a largely maintenance free food production ecosystem.



Zero-to-Hero Portable Mini Version

The pictures you'll see in this instruction manual are from a smaller version of the system you're building. I use this smaller system to bring to events so people can experience aquaponics first hand. Your system will have about 3 times the fish tank space and 5 times the growing area. The schematic drawings show the full-sized system.

I'm Jeremiah. If you have comments or suggestions for improving this manual, I'd love to know! If you like these plans (or if you don't), write a review at plus.google.com/+ColdWeatherAquaponicsMadison.

[Frosty Fish Aquaponic Systems](#) specializes in aquaponics systems for use in cold climates. As far as I'm aware, we're the only ones in the world who do.

And let me be the first to welcome to the crazy community of people who do



Parts List

Category	Item	Per	Quantity
Bio-Filter	6 Gallon Bucket Lid	Each	1
Bio-Filter	6 Gallon Food Safe Bucket	Each	1
Bio-Filter	Moving Bed Media	Ft ³	1
Bio-Filter	4' 2x12 Treated Board	Each	1
Fish Tank	18"x24" Acrylic Sheet	Each	2
Fish Tank	Lexel	Tube	2
Fish Tank	Potable Water Safe Submersible Paint (with instructions)	Quart	1
Fish Tank	4'x3'x2' Used Freezer	Each	1
Plumbing	1" PVC Elbows	Each	8
Plumbing	1" PVC Valve	Each	1
Plumbing	1" PVC Pipe	10 ft	3
Plumbing	1" Uniseal	Each	6
Plumbing	1" Male Slip-Fit Screen	Each	3
Plumbing	1" Slip to 1/2" Male Threaded Elbow	Each	1
Plumbing	130 GPH Pump	Each	1
Heating	1000W Submersible Heater	Each	1
Heating	Heater Controller	Each	1
Filter	5 Gallon "Better Bottle"	Each	1
Filter	"Better Bottle" Plug	Each	1
Filter	1/2" Hose Barb Coupling	Each	1
Filter	1/2" Hose Barb Valve	Each	1
Filter	1/2" Rubber Tubing	Ft.	1
Filter	1/2" Rubber Grommet	Each	1
Filter	12-15" High, 10" Diameter Plant Stand	Each	1
Aeration	20' Air Hose Tubing	Each	1
Aeration	4-Outlet Aerator	Each	1
Aeration	6" Air Stone	Each	4
Grow-Bed	Frisbee (seriously)	Each	1
Grow-Bed	4'x8' Sheet 2" XPS Styrofoam Insulation	Each	2
Grow-Bed	4'x8' Sheet 1" XPS Styrofoam Insulation	Each	1
Grow-Bed	4'x8' Sheet Treated 1/2" Plywood	Each	1
Grow-Bed	2" x 2" Treated Wood	8 ft.	5
Grow-Bed	11.5'x10' Dura-Skrim Liner	Each	1
Grow-Bed	1-1/2" Outdoor Wood Screws	Box	1
Grow-Bed	3" Outdoor Wood Screws	Box	1
Grow-Bed	3/8" Construction Staples	Box	1
Grow-Bed	Pack Coco Coir	650g	1
Grow-Bed	3" Net Pots with Lip	Each	66
Grow-Bed	Lettuce Seed Packet	Each	1
Electrical	20' Three-Outlet Outdoor Extension Cord	1	1
Electrical	In-Line Plug GFCI	1	1

Prices and where-to-buy on page 19.



Tools

- Powerful drill (preferably corded)
 - * ¾" Spade Drill Bit
 - * 1 ¼" Hole Saw*
 - * 1 ¾" Hole Saw
 - * 3" Hole Saw
- Painting Materials*
 - * (2) 1-cup measuring cups
 - * (2) 3" paint brushes
 - * Quart-size plastic container
 - * Disposable shop towels
 - * Paint respirator (not optional – you will be using nasty chemicals)
 - * Xylene (solvent)
 - * Rubber gloves
- Caulk gun
- Wood Chisel (any size)
- Reciprocating saw, jigsaw with min. 3" metal cutting blade (or you can make do with a hacksaw)*
- Hammer*
- Duct tape*
- Ammonia*
- 100 grit sandpaper
- Tape measure
- Sharpie
- Pencil
- Pliers
- Utility Knife
- Leather Work Gloves
- Long Straight Edge (straight piece of wood works good enough)
- Wood Cutting Saw (hand saw, chop saw, or circular saw)

* These items used with the freezer-to-fish tank conversion, instructions found [here](#).

Notes

- All this work must be done in a very well-ventilated area. Working with Lexel and epoxy paint must be done where temperatures (including overnight) will not drop below 40 °F.
- This manual requires you to work with chemicals and tools which can be dangerous if used improperly. Please follow all manufacturers' instructions on the use of their products. Frosty Fish is not liable for the use of any products outside the manufacturer's written instructions. If you are not experienced with any of these tools, ask a friend who is to help you.
- This manual recommends the use of potable water safe products wherever possible. In particular we recommend using potable water safe paint. Non-potable water safe paint will release unsafe chemicals into your water, where they will concentrate in your fish... that you will eat. Then they will concentrate in you !
- PVC piping is not listed as potable water safe primarily because it releases chemicals in the presence of high temperatures, which this system will not encounter. Some may release due to UV light, but that's on the outside of the pipes (i.e. released to the air, where your fish can't eat them. Rigid PVC does not contain BPA.



Prepare Materials

As my dad always told me, there's no good reason not to get all your materials prepped before you start. You'll enjoy the process more if you do, and hopefully make fewer mistakes. Some of these materials you're working with are expensive, so being careful is key to saving money.



Dura-Skrim

Cut your Dura-Skrim to size. You want it to be 10' long and 7' wide. There will be excess at the end, but it's better to have too much than too little. It doesn't have to be exactly straight, since you will be trimming some off at the end.

1. To do this, lay the Dura-Skrim out on a flat surface
2. With a tape measure and a Sharpie, mark the Dura-Skrim at 10' x 7'.
3. With a long straight edge, cut the whole way through using a utility knife with a sharp blade.



Insulation

Item #	Description	Quantity	Size	Purpose
N1	2" XPS	1	44-3/4" x 92-3/4"	Base
N2	2" XPS	2	92-3/4" x 12"	Long Edge
N3	2" XPS	2	44-3/4" x 12"	Short Edge
N3	1" XPS	1	96" x 48"	Top



1. Using another piece of insulation as a straight edge, mark the line for your cut with your sharpie.
2. Cut the insulation with a utility knife—shallow on the first pass, then as deep as it will go.
3. Break the insulation across a piece of wood where you cut it. This is very satisfying

Wood

Item #	Description	Quantity	Size	Purpose
W1	2x2 Treated	20	12"	Risers
W2	2x2 Treated	4	96"	Long Edge
W3	2x2 Treated	4	44-3/4"	Short Edge
W4	1/2" Plywood Treated	1	4'x8'	Base
W5	2x12 Treated	2	8"	Bucket Base
W6	2x12 Treated	2	9-1/2"	Bucket Base

Cut wood pieces with any kind of wood cross-cutting saw you're comfortable with. These include a hand saw, Japanese pull saw, circular saw, chop saw, or even a reciprocating or jigsaw. Your cuts for this project don't need to be finished carpentry quality, just good enough for your fish.



Pipes

Piping is the one area where I recommend waiting to cut. So much of plumbing depends on what's going on your specific circumstances that it's hard to give specific guidance.

For piping, I recommend that you wait till everything is in place before you cut pipes. Much plumbing experience tells me that if you cut first, your cuts will be $\frac{1}{4}$ " too short (or too long) every time.

Start Seeds

Given that you're going to grow plants in this new system, if you have the opportunity it's a good idea to start your seeds a few weeks before you build (perhaps when you order your parts). 4" tall seedlings work well, though larger plants work fine (depending on the plant). You can even start seeds in aquaponics. It takes about a month for lettuce seedlings to reach 4" tall, longer for spinach and most other small-seeded plants.

For more on starting seeds, visit your local garden center. Or ask your grandmother.



The Freezer Fish Tank

If you want to raise fish and plants when it's below 50°F (10°C) outside, which can happen any month of the year where I live, you'll want to make your fish tank out of something insulated and air sealed. If you don't, you'll watch your electric meter spin.

For this, I recommend old chest freezers. They're inexpensive, easily attainable, durable, and *highly* insulated and air sealed.

Here is a [blog post](#) on where to find an old freezer. It's not as hard as you might think, and you'll get to meet some interesting people who – when you tell them you want the freezers with the refrigerant removed – will think you're burying dead bodies. Telling them "I'm not going to use these to bury dead bodies" won't reassure them.

The instructions for converting a freezer to a fish tank are available on the [Fish Tank to Freezer Conversion](#) page, or available free with [fish tank paint](#) as listed in the parts list.

Other Options

If you choose to use another type of tank for your fish, you'll want to make sure it's at least 100 gallons, and that the top is raised 36" off the ground. You'll also want a lid that prevents fish from jumping out yet allows enough light in that the fish can see their food. It should also be potable water safe.

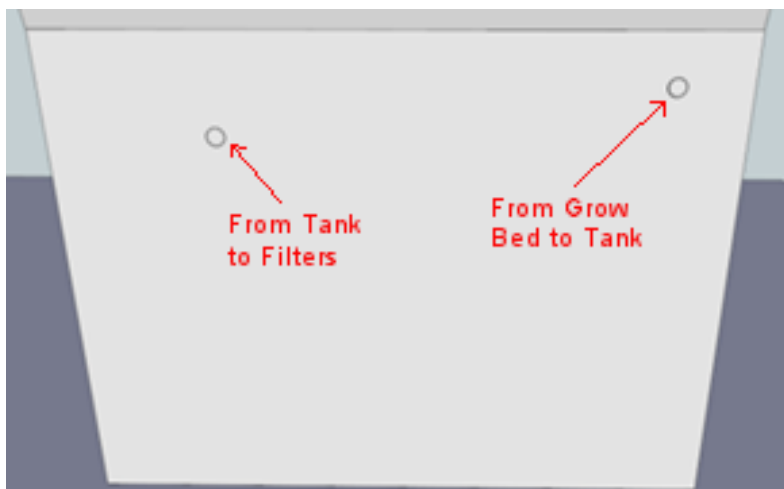
If your tank is made from a single-walled plastic or metal material, you can make the penetrations using your 1-3/4" hole saw with Uniseals.

See the instructions on how to do this in the plumbing section of this manual. You'll want to select two spots on the back of your tank.

Drill one about 12" from the top, and another about 3" from the top, as shown in the image.

The higher one should be on one side, the lower one on the other side.

Drill slowly, all the way through, trying to keep the hole straight.

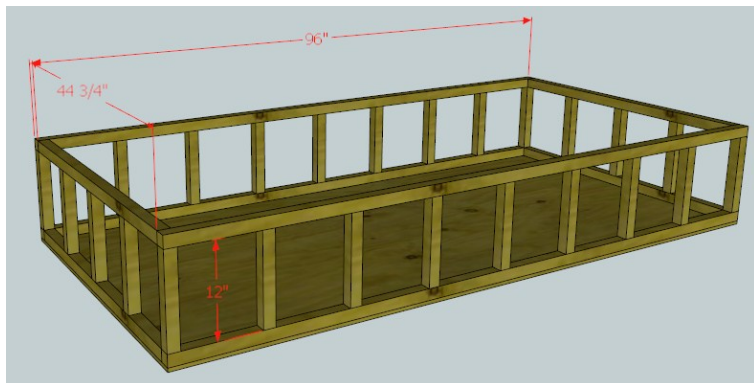


Grow Bed

The Frame

A full sized (2x4x3') chest freezer and a 4x8' grow bed work out nicely and use standard-sized materials, saving time and money.

1. Start by screwing two of your 96" 2x2 pieces (W2) and two of your 44-3/4" 2x2 pieces (W3) to your plywood (W4) with 1 1/2" outdoor wood screws. Screw the pieces to each other at the corners using 3" outdoor wood screws.
2. Next, using your 3" outdoor screws, attach 12" long 2x2 risers (W1) to the top, starting at the corners and adding a riser every foot. You can toe-screw them, or screw them in from the bottom.
3. Attach the remaining pieces (W2 and W3) to the top of the risers and to each other, creating a nice boxed-in frame.

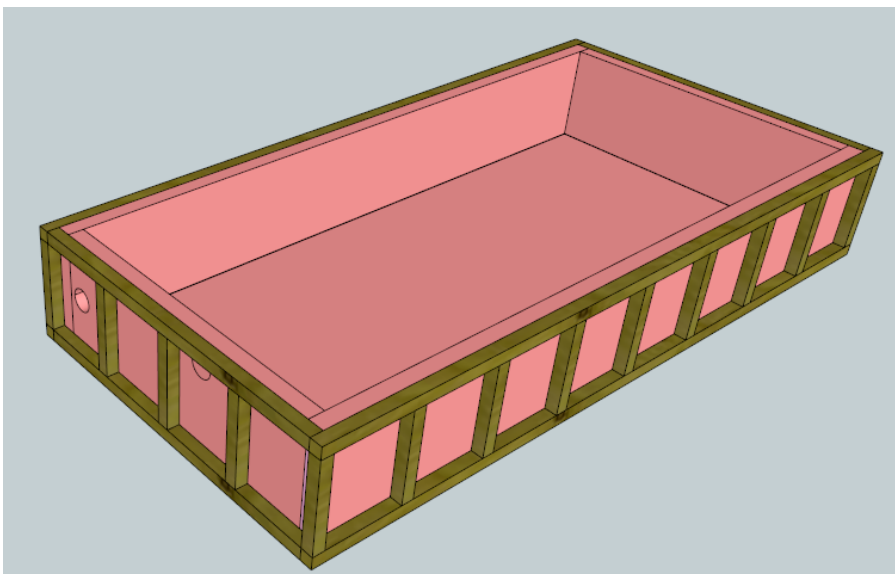


Insulation

Sides and Bottom

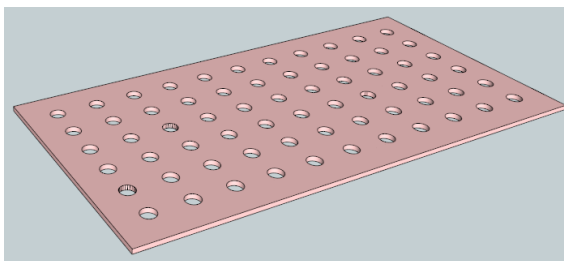
1. Take the bottom piece (N1) of insulation and set it inside the frame, on the bottom. If it won't fit, trim some off using your knife or a jigsaw.
2. Put the sides in place (N2 and N3). They should fit snugly but installing them shouldn't put too much pressure on the wood.

The insulation in the picture shows holes for the pipes. You'll cut these later.



Top

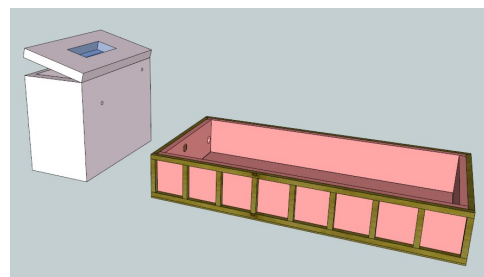
Next, take your 3" hole saw and cut holes for your plants in the grow bed top (N3). The spacing is up to you, but you should not let the edges of any of the holes come closer than 5" from the outside edge of the insulation. For growing greens and herbs, 8" spacing works well. Larger vegetables take more space though some (such as tomatoes) can be trellised.



1. The best way to lay out your holes is to take the net pots and lay them out on the insulation, opening-down, so you can see what you want your layout to look like. Mark around each net pot where you're going to cut.
2. Drill the holes with the 3" hole saw by pushing the mandrel (the drill bit part) into the insulation until the teeth of the hole saw touch the surface. Start slowly and then go faster. Keep your fingers away and be careful. Perhaps try a practice sheet first. It's easy to mess up your first time and slip the hole saw out of the hole, marking up the insulation, like they did in the picture. If this happens, it might not look great but will still work.

Arrange the Pieces

Place your grow bed in its final location, on a stable, flat surface, with the side of the fish tank with the holes cut facing toward it, about 24" away.



Filter Mounting System

Before connecting the plumbing, you'll build the mounting system for your bucket and bottle.

Bucket

1. Arrange your 4' treated 2x12, cut into four pieces (W5 and W6).
2. Taking your 3" outdoor wood screws, build a little box as shown in the image.
3. Screw it to the grow bed at the corners which touch the grow bed.



Bottle

1. Take your plant stand and rest the bottle upside-down on top of it.*
2. To attach the drain to the bottle, take the bottle stopper and drill a hole through the center using your 3/4" drill bit.
3. Put the 1/2" rubber grommet in the hole. If you are using a two-sided grommet, make sure that the lips from both sides curl over the edge of the bottle stopper.
4. To make your drain hose, plug your 1/2" hose barb adapter into the grommet. Cutting your flexible hose in half, attach one section, the 1/2" hose barb valve, and then the other section as shown in the image (you can adjust the hose lengths to your preferences). Plug the whole assembly into the bottle tightly.

* You could also modify an old popcorn tin, if you're creative. Just be sure not to ruin the structure of the tin with your modifications. Also, make sure that the plant stand (or whatever you use) is on something solid. A piece of treated plywood works well.



Plumbing

Overview

For this part, it's easier to show you diagrams than to try and explain in words.

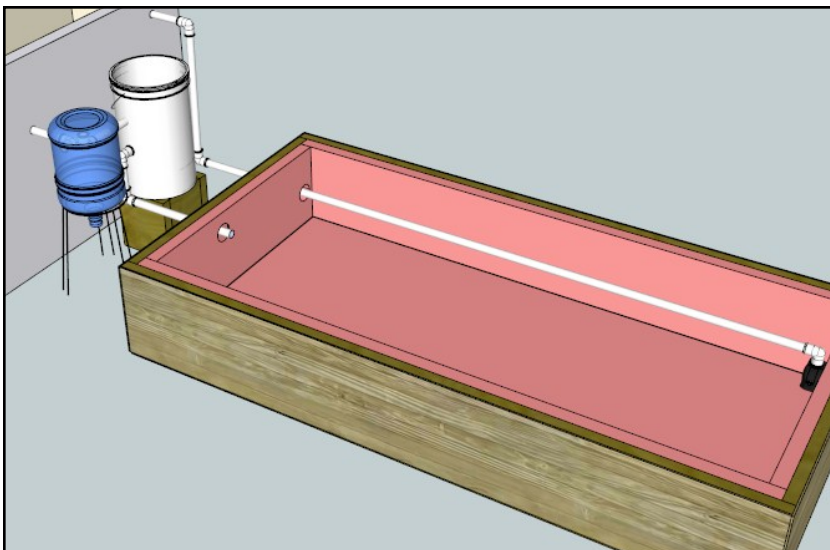
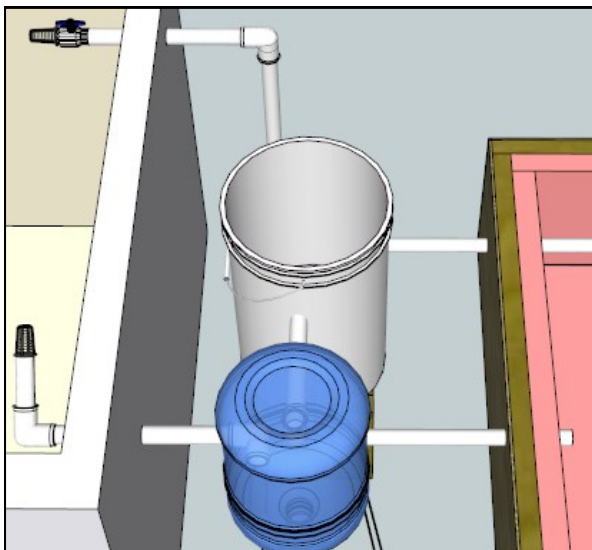
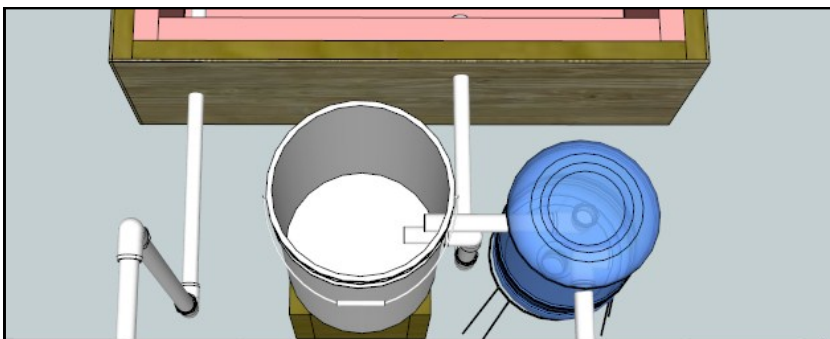
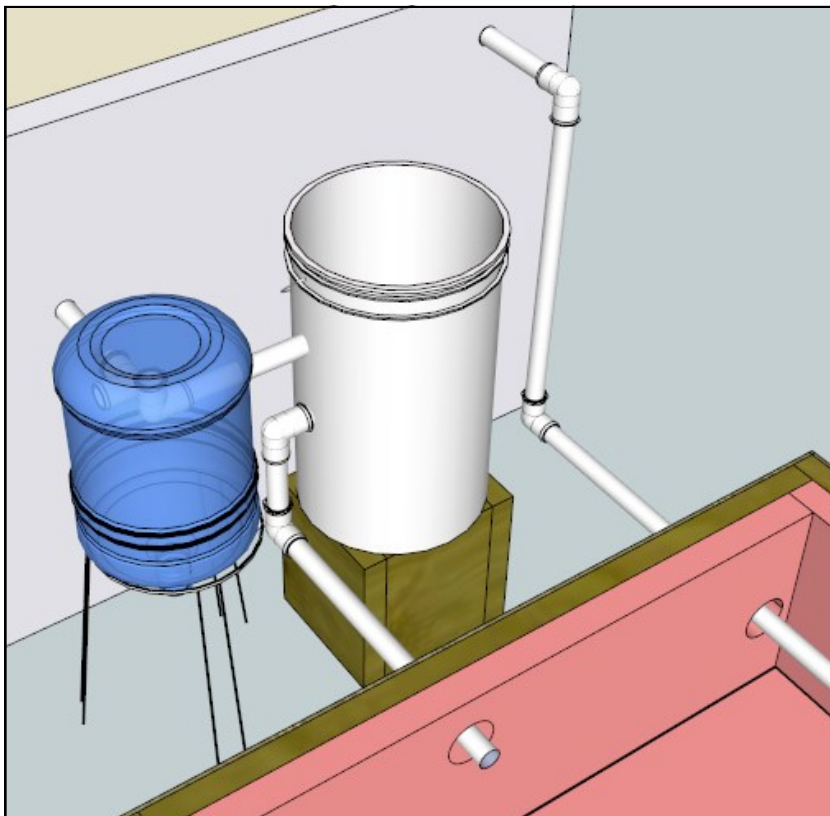
You're going to line everything up, measure, and mark each piece individually. Nothing needs to be exact, but it does have to be in about the right spot relative to the other things. Clear as mud? Let's take a look.

As shown here, you're adding two containers to your system, both of which act as filters. The 5-gallon bottle acts as a solids filter, allowing solids to drop to the bottom where you can drain them. The six-gallon bucket acts as a bio-filter, which when filled with Moving Bed Media converts your toxic fish waste to non-toxic plant fertilizer.

You may see other systems being used without these two components. They can work without them, but you must stock your tank with very few fish, which limits how much you can grow. Systems with media-filled grow beds that flood and drain periodically can be an exception, though they also benefit from filters like these.

The diagrams shown represent the easiest, most-direct way to run the plumbing. In the pictures shown on the following pages, the plumbing runs don't match exactly.

See the next page for approximate dimensions.



Cut and Dry-Fit

It's time to start plumbing! Are you excited?

Don't worry. While you will probably make a few cuts too long and a few too short, it's okay. PVC pipe is inexpensive and easy-to-work-with. Fixing mistakes is no problem.

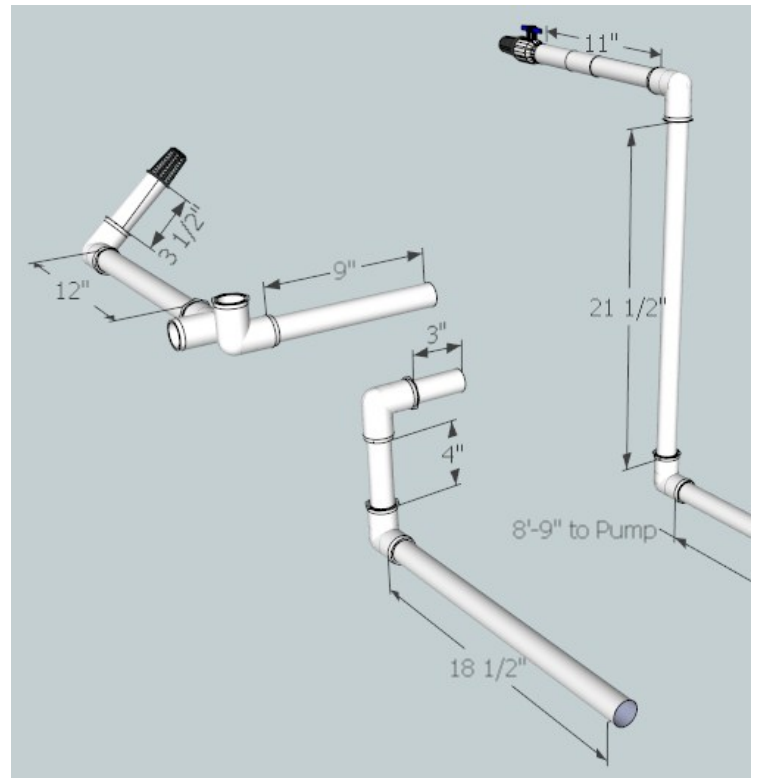
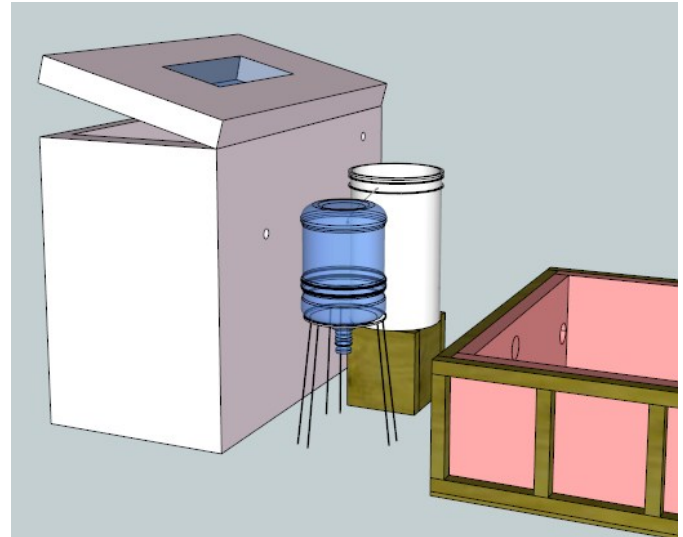
1. Put the bucket and bottle on their respective stands.
2. With your Sharpie, mark on the bucket and bottle at the center of each pipe penetration.*
3. Holding the fittings in place, measure the length of pipe for each cut as shown in the pictures on the previous page. The diagram below shows approximate distances between fittings. Distances will vary based on exactly how you set things up in your space with your materials. Where pipes connect to fittings, they must have 1/2" to 1" more length than shown in order to slide into the fitting.**
4. Cut one piece at a time and dry-fit (slide into place without gluing) into the associated fittings.
5. Once you've got your plumbing cut and dry-fit, file the ends that make penetrations into the bucket and bottle filters. These pieces will need to slide through the Uniseals. You file them by using your sandpaper, so that the ends of the pipe are tapered and will slide through more easily.

*** Notes on Bottle Penetrations:** On the bottle, you'll see that there are some ridges. You want the Uniseal penetrations to go where there are no ridges, preferably in the center of the smooth part between ridges. Inside the bottle, the elbows will point to the side as shown, to create a swirl action that causes solids to settle out.

On the bottle, the supply connection should be below the drain connection.
On the bucket, it doesn't matter which is above or below.

****** Put the pump at the far end so the water will flow through the whole grow bed, moving the oxygen and nutrients everywhere.

Both the pipes that go into the grow bed should penetrate at least 3" below the top of the grow bed.



Drilling Holes in Filters

To connect the components, you'll need your 1-3/4" hole saw and your bucket and bottle. Since you've marked the center of where the pipes go through, you should be able to put the mandrel (the drill bit part) right at your mark and drill through.



1. Starting with the bottle, drill your holes with the hole saw very, very slowly.*
2. Take off all the burs and scrape off irregular edges with your chisel, and slide two Uniseals into the holes in the bottle.
3. Check again that the pipe locations seem to fit with the hole in the bottle cut.
4. Cut the holes in the bucket the same way.
5. Slide two Uniseals into the bucket.
6. Check pipe locations and lengths again.
7. With your 3" hole saw, cut a hole in the bottom of the bottle (the top when it's flipped upside-down), to give your hand a space to reach in.

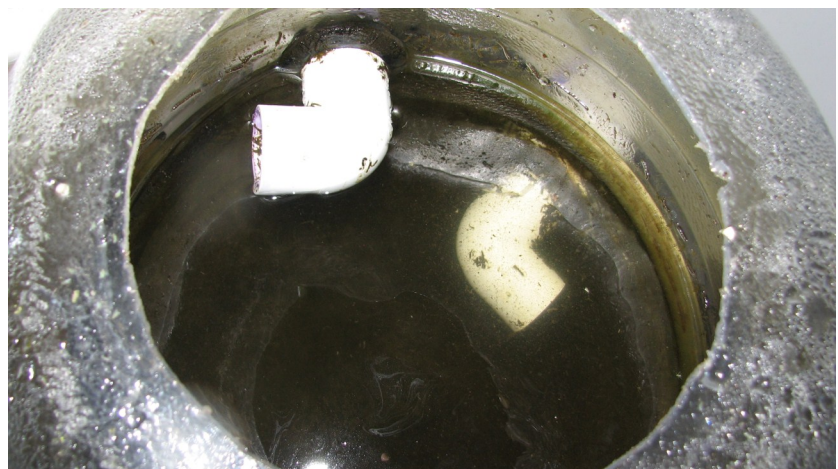
* If you look at my picture you'll see that there is one spot with a bunch of Lexel and Epoxy around the Uniseal. That's where I messed up one of my holes. It still leaks very slowly. The moral: Cut slow and carefully, especially at the beginning and the end of the cut.

You'll also notice that my bottle Uniseals are on the inside. This is because they're too close to the ridge parts of the bottle. Had they been on the outside—given where I cut the holes—they wouldn't have sealed as well.

Pipes in Uniseals

If everything fits right, you can go ahead and install your pipes through the Uniseals.

1. Review the diagrams on pages 10-11 to make sure the right ends of the right pipes go through. Once they're in, it's hard to get them out.
2. Apply some Vaseline to the part of the Uniseals where the pipes go through. Sliding them in will take some force, but isn't complicated.
3. With one hand supporting the bucket or bottle push each length of pipe through each Uniseal about 1 inch.
4. When all the pipes are in, dry-fit the rest of the components together and slide each pipe the rest of the way in.



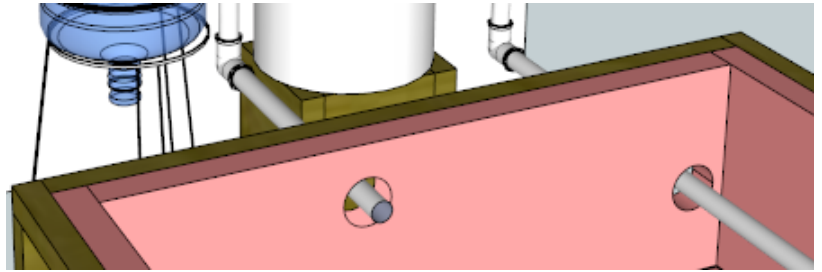
Interlude: Back to the Grow Bed

With that done, we're going to leave plumbing for a few minutes to finish the grow bed.

Holes in Insulation

First, now that you know where the plumbing is going to penetrate the grow beds, you'll want to cut the holes for the penetrations through the insulation first.

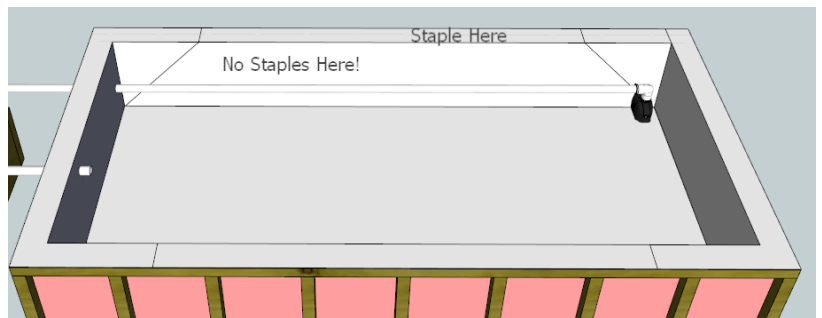
Using your 3" hole saw, cut holes through the insulation roughly where your pipes will go through. Because you're making larger holes than the pipes, they don't need to be exact.



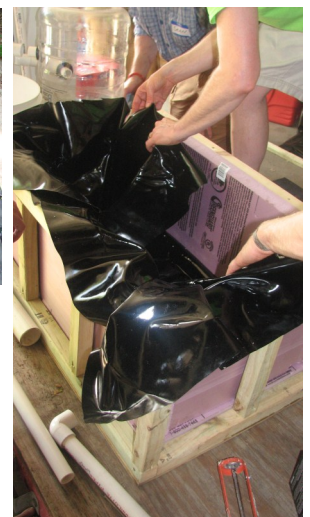
Dura-Skrim Folding and Cutting

Once the holes are cut, you're ready to install the Dura-Skrim.

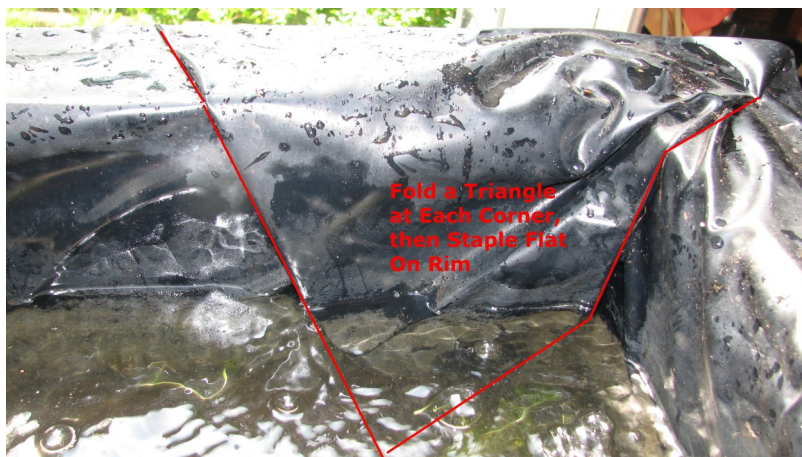
You're going to be putting staples into the Dura-Skrim, so I should be clear that you **never put staples below the rim of the grow bed**. If you did, it would leak in that location. Staples should never go below the water level. If you mess up, there are ways to fix it. But it's better not to have to go there.



1. First, take the two long sides of Dura-Skrim and mark the halfway point. Then on the two long sides of the grow bed mark the center.
2. Line up the Dura-Skrim so that one of the marks meets the mark on the grow bed.
3. Fold the Dura-Skrim over itself a couple of inches so you have two layers over the wood, and put a few staples in.
4. Smooth the center of the Dura-Skrim across the bottom of the grow bed so that—between the two marks you made—the Dura-Skrim is touching the insulation the whole way, plus a small amount of slack.
5. Find the mark you made on the other side of the Dura-Skrim and the grow bed, and put in one staple through the Dura-Skrim into the wood rim, to hold it in place.
6. With the liner held in place by the staple, cut off the excess slack, such that the liner has a few inches that hang over the edge of the grow bed.
7. Pull out your staple, fold those few inches under, and put in a few staples where before you had put one.



8. Fold down a line of Dura-Skrim against the bottom of the short edge of the grow bed. Pull the edge tight on one side and staple it just before the corner, folding over as you did before. Smooth this line down across the bottom of the grow bed along the edge, such that there's a little bit of slack, just like you did in the middle.
9. Do the same thing on the opposite side.
10. Most of the Dura-Skrim is laying smoothly in the bottom of the grow bed, with a floppy bit hanging over the end on both sides. You can trim off some of the floppy bit, leaving about 3" hanging over the end on either side.
11. Next you're going to fold one of the corners that's hanging over the edge such that it lays flat inside the grow bed, as shown in the photograph. Follow up with the other three corners. With them in place, you can smooth out the bottom of the grow bed so that all the surfaces are smooth with no creases or spots that are stretched so they can't touch the bottom. If you make a mistake, take out the necessary staples with a small flathead screwdriver or staple remover and redo that portion.
12. Once the liner is anchored, put in staples every 2" all the way around the rim.



Uniseals in Dura-Skrim

Now you're going to make penetrations through the Dura-Skrim. To make this easier, you're going to use your frisbee.

1. Take the Frisbee and your utility knife, and cut .off the rim of each frisbee. You're going to use the flat part—one for each Uniseal penetration.
2. Once those are cut you're going to make a smaller hole inside each large hole, to form a doughnut. Cut the smaller hole with your 1-3/4" hole saw. To do this, set what's left of your frisbee on a piece of wood, hold it with a pliers, and wear your leather work gloves.
3. Take off the burs and irregular edges with your chisel., being careful not to gouge the plastic
4. Line up the doughnuts where your pipes will penetrate (but don't put them through yet).
5. Sand one side of each doughnut, smear some Lexel over the sanded side, and stick it against the Dura-Skrim through the holes you cut in the insulation, taking care not to get any Lexel on your clothes or hair. It will be movable for a few minutes, so put both of them in place, stick them tightly, and check your plumbing. ***The Lexel will need 24 hours to dry.***



6. Once dry, you can cut an “X” through the Dura-Skrim, **slightly smaller** than the hole in the doughnut. Fold the pieces through from the inside to the outside.
7. Holding the outside firmly, take your Uniseal and put it through the hole. This sounds easy, but it isn’t. If the piece of doughnut frisbee breaks during this process, you’ll need to make another one.
8. Sand the edges as before, and apply some Vaseline to lubricate the Uniseals.
9. Slide the pipes through, applying counter-pressure from the outside so as not to rip the Dura-Skrim liner.



Connecting the Pipes

This is the exciting part, where everything starts to come together!

Having marked out where all the pipes go and checked their configuration many times, they should be right.

Only the pieces that are outside of the water need to be glued. Anything underwater can remain unglued since it doesn’t matter if it leaks. It’s also nice to be able to take apart.

1. Put all the pipes that will be underwater in their final locations.
2. Take the foam filter out of your pump (you don’t need it), attach the pump to the long PVC pipe running the length of the grow bed with the 1” to ½” threaded elbow, and stick the suction cups to the Dura-Skrim bottom.
3. One section at a time, take the non-underwater sections apart, and clean the ends with paper towel or a clean rag.
4. Cover the last inch of both the pipe ends and the insides of all fittings with PVC primer. Primer is nasty stuff, so its best to wear gloves and your ventilator mask. It dries quickly—in a minute or so.
5. Wait a minute and add the glue. This needs to happen fast, as the glue dries to an immovable state in about 10 seconds. One piece at a time, put the glue on the fitting and the pipe, and slide them in place. Move quickly so you can do the next piece while the previous one is still drying.

Now you’re done with the plumbing!



Now You Wait

Your system is basically done. Now you wait.

The paint will take 7 days to fully cure – more if it's cold outside. Follow the paint manufacturer's instructions for cure time.

In the meantime, you could read up on aquaponics [books](#), [forums](#), and [blogs](#) so you're ready once the system is up and running.

Or you could do something else.



Connecting, Filling, and Testing

With everything connected, you can start putting the parts in their places, starting with the heater.

Water Heater

1. Mount the heater controller on the side of your freezer (or on/near your fish tank, if you're using another type of tank) per the instructions that come with it. Put it wherever you're most likely to see it when you feed your fish, such as near the front of the tank.
2. It will come with a probe that reaches into the water. You can drape this over the edge into the fish tank.
3. Program the heater controller for the ideal temperature of the fish you're using, again following the instructions included. Ask the hatchery what temperature to set it at. If it's cold out, you may want to deviate from the ideal temperature a bit to save energy.
4. Plug the heater into the heater controller and let it rest on the bottom of the fish tank.
5. Connect the 20' 3-outlet outdoor cord to an electrical outlet through your in-line GFCI. Plug the heater controller in.



Aeration

1. Take the air stones and put two in the bucket, one in the bottom of the grow bed, and one in the bottom of the fish tank.
2. Measuring your air hose so that it can reach from the location you'd like your aerator to sit to each air stone, cut the sections of air hose and attach them to the aerator and the air stones. Note that you'll want the hose connected to the aerator in the bucket to go through the grommet in the lid of the bucket. You can slide this through *now or later*.
3. Plug the aerator in.



Fill 'er Up

Time to fill your system with water!

1. Pour enough of the moving bed media into the bucket so that about 3" of the top of the bucket is free.
2. Fill slowly, into your grow bed.
3. When the water clears the pump, plug in the pump.
4. Regulate the valve so that the pump is not supplying more water to the fish tank than the drain can handle, and making sure that none of the components overflows. If one does, stop the water and start again once the water level has regulated itself. This may take some fiddling with the valve, but it'll work when you've set it right.
5. Adjust the aerator, making sure that no air is leaking and that bubbles are reaching the surface in all locations.
6. Spend some time with the system, enjoying your handiwork and making sure that everything is working together properly.



Adding Living Things!

Plants

Next you can put the plants in their places. Assuming you've been starting seeds and so now have 4" seedlings, they're the perfect size to plant! Put your seedlings in the net pots and fill in around them with coco coir. Put the grow bed top and net pots in place.



Bacteria and Water Testing

First wait three days for the chlorine to evaporate.

You'll want to cycle the bacteria in your system next. There are a lot of ways to do this which you can read about in various [books](#) and [forums](#).

Regardless of method, you'll want to do water testing to see when your system is finished cycling.

1. One method is to add pure ammonia (available from Ace Hardware) or aged urine (left to sit at least two weeks). Add enough so that—once the water has cycled through—you start to see ammonia in your test kit.
2. Add your bacteria culture into the moving bed media. You can get a sponge full of bacteria from a reputable pet store. (You can also buy bacteria in a bottle that claims it allows you add fish right away. This is a lie.)
3. With ammonia and bacteria in your system, test your water every day and keep adding ammonia to keep the levels high enough that you can measure them, until you begin to see nitrites. Add less ammonia now, until the ammonia and nitrites are gone and nitrates begin to appear. One that happens your water chemistry is stable.



Fish

Starting with an easy fish is a good idea. Goldfish are the easiest. If you want an edible fish right away, choose tilapia (but check to make sure they're legal in your area). You can order them online or find a local supplier. Stock your fish so that you'll never have about 35 lbs of fish in the tank when they're full size.

Or you can head to your local hatchery and pick out something that the hatchery owner recommends. Depending on your state, you may need a DNR permit to get fish from a hatchery. Let the hatchery owner know if you're going to shut the system down for winter, so that you can get something that will grow out by that time. Ask them what to feed your fish depending on the size you purchase.

If there's nothing that will (such as if you start your system in October), you might as well get goldfish and practice with them.

Done. What's Next?

That's it. There's a lot more to know, but this is enough to get you started and hopefully get you excited enough that you want to learn more.

Some suggested improvements include:

- High-tech Arduino or Raspberry-Pi Controller
- Tank-bottom solids sucking drain (as shown in [freezer conversion plans](#))
- Backup aerator and backup power for aerators.
- Low tunnel over grow bed
- Piping insulation
- Insulation for filters
- Trellaces for vining plants
- Hoop or green house for further protection and expansion
- Scuds (grammarus shrimp) to clean grow beds and supplement fish feed
- Black soldier fly composter for supplemental fish feed
- Hot tub for your greenhouse

If you have questions or problems you can find answers on [this blog](#) or at the [various forums](#).

Keep in mind that—as I've said before—you will kill fish and some of your plants will die. This is a natural part of learning how aquaponics works, and how it works in your climate.

Soon enough, though, you'll be eating thousands of dollars worth of the freshest, tastiest, safest fish and veggies that you've ever had. You've already put in the hard work. While you will want to make improvements in the future, you're on your way to a largely labor-free, highly productive small-space garden.



Largemouth Bass



Catfish



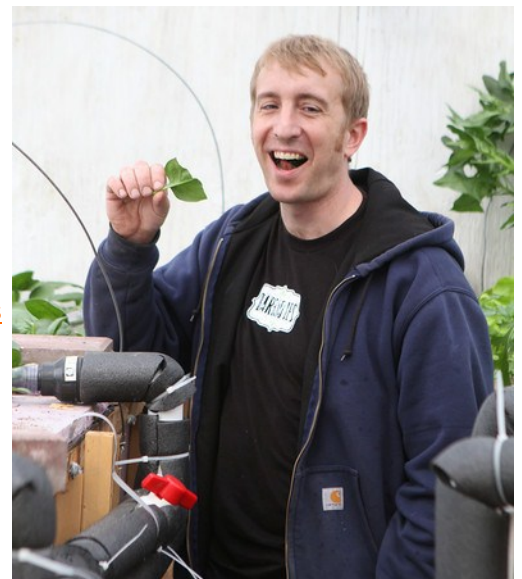
Yellow Perch



Rainbow Trout



Nile Tilapia



FROSTY FISH
AQUAPONICS FOR COLD CLIMATES

Parts and Prices (All "Where to Find" links are to specific product pages)

Category	Item	Per	Cost Each	Quantity	Total Cost	Where to Find
Fish Tank	Potable Water Safe Submersible Paint (with freezer-to-fish tank conversion instructions)	Quart	\$60.00	1	\$60.00	Frosty Fish Aquaponics
Aeration	20' Air Hose Tubing	Each	\$5.00	1	\$5.00	Frosty Fish Aquaponics
Aeration	4-Outlet Aerator	Each	\$28.95	1	\$28.95	Frosty Fish Aquaponics
Aeration	6" Air Stone	Each	\$1.50	4	\$6.00	Frosty Fish Aquaponics
Bio-Filter	Moving Bed Media	Ft ³	\$28.00	1	\$28.00	Frosty Fish Aquaponics
Bio-Filter	6 Gallon Bucket Lid	Each	\$2.99	1	\$2.99	Frosty Fish Aquaponics
Bio-Filter	6 Gallon Food Safe Bucket	Each	\$12.00	1	\$12.00	Frosty Fish Aquaponics
Filter	1/2" Hose Barb Valve	Each	\$3.20	1	\$3.20	Frosty Fish Aquaponics
Filter	1/2" Rubber Tubing	Ft.	\$0.60	1	\$0.60	Frosty Fish Aquaponics
Filter	1/2" Rubber Grommet	Each	\$0.50	1	\$0.50	Frosty Fish Aquaponics
Filter	5 Gallon "Better Bottle"	Each	\$24.00	1	\$24.00	Frosty Fish Aquaponics
Filter	"Better Bottle" Plug	Each	\$1.50	1	\$1.50	Frosty Fish Aquaponics
Grow-Bed	Pack Coco Coir	650g	\$3.10	1	\$3.10	Frosty Fish Aquaponics
Grow-Bed	3" Net Pots with Lip	Each	\$0.45	66	\$29.70	Frosty Fish Aquaponics
Grow-Bed	11.5'x10' Dura-Skrim Liner	Each	\$59.95	1	\$59.95	Frosty Fish Aquaponics
Heating	1000W Submersible Heater	Each	\$50.00	1	\$50.00	Frosty Fish Aquaponics
Heating	Heater Controller	Each	\$50.00	1	\$50.00	FF Kit (\$50) , Prefab (\$90) , or Outdoor Rated (\$99)
Plumbing	130 GPH Pump	Each	\$23.00	1	\$23.00	Frosty Fish Aquaponics
Plumbing	1" Uniseal	Each	\$1.50	6	\$9.00	Frosty Fish Aquaponics
Plumbing	1" Male Slip-Fit Screen	Each	\$1.50	3	\$4.50	Frosty Fish Aquaponics
Plumbing	1" PVC Valve	Each	\$3.00	1	\$3.00	Frosty Fish Aquaponics
Filter	12-15" High, 10" Diameter Plant Stand	Each	\$17.00	1	\$17.00	Avant Garden Supplies
Fish Tank	4'x3'x2' Used Freezer	Each	\$25.00	1	\$25.00	Local Appliance Salvage Yard
Grow-Bed	Frisbee (seriously)	Each	\$4.00	2	\$8.00	Local Sports Store
Grow-Bed	Lettuce Seed Packet	Each	\$2.95	1	\$2.95	Local Garden Store
Bio-Filter	4' 2x12 Treated Board	Each	\$10.00	1	\$10.00	Local Lumberyard
Grow-Bed	4'x8' Sheet 2" XPS Styrofoam Insulation	Each	\$24.00	2	\$48.00	Local Lumber Yard
Grow-Bed	4'x8' Sheet 1" XPS Styrofoam Insulation	Each	\$18.00	1	\$18.00	Local Lumber Yard
Grow-Bed	4'x8' Sheet Treated 1/2" Plywood	Each	\$21.00	1	\$21.00	Local Lumber Yard
Grow-Bed	2"x2" Treated Wood	8 ft	\$2.50	5	\$12.50	Local Lumber Yard
Fish Tank	18"x24" Acrylic Sheet	Each	\$14.00	2	\$28.00	Local Hardware Store
Fish Tank	Lexel	tube	\$9.00	2	\$18.00	Local Hardware Store
Plumbing	1" PVC Elbows	Each	\$1.15	8	\$9.20	Local Hardware Store
Plumbing	1" PVC Pipe	10 ft	\$3.50	3	\$10.50	Local Hardware Store
Plumbing	1" Slip to 1/2" Male Threaded Elbow	Each	\$2.00	1	\$2.00	Local Hardware Store
Filter	1/2" Hose Barb Coupling	Each	\$1.25	1	\$1.25	Local Hardware Store
Grow-Bed	1-1/2" Outdoor Wood Screws	Box	\$7.00	1	\$7.00	Local Hardware Store
Grow-Bed	3" Outdoor Wood Screws	Box	\$7.00	1	\$7.00	Local Hardware Store
Grow-Bed	3/8" Construction Staples	Box	\$3.00	1	\$3.00	Local Hardware Store
Electrical	20' Three-Outlet Outdoor Extension Cord	1	\$20.00	1	\$20.00	Local Hardware Store
Electrical	In-Line Plug GFCI	1	\$13.00	1	\$13.00	Local Hardware Store
Estimated Total Cost					\$686	
Cost with Shipping					\$734	

Buy all Frosty Fish products needed for the Zero-Hero System at a discount here: [Zero-to-Hero Kit](#)