Introduction

The “Aquafarm”

This system was developed and popularized by General Hydroponics nearly twenty years ago as their first product. The original design, which is still in production, is known as the "Aquafarm". In recent years it has seen new embodiments named the "Watergarden" (a decorative version), the "Powergrower" (a revised version of the watergarden), the "Waterfarm" (a square version), and the "Megafarm" (a 20 gallon version). A similar bucket based system is also being sold by another company under the name of the "Universal Garden". These units are extremely reliable, easy to operate and are very simple to construct. All of these systems retail in the 50 dollar per unit range. This document will show you how to build this type of system for very low cost.

This system will accommodate several small plants or (as best suited for) hold one large plant. I personally have seen a 12 foot tall tree being grown in an aquafarm, as well as a very large banana tree, both indoors. The plants are grown in a chamber suspended above a reservoir (basically a bucket within a bucket) that holds the nutrient solution. A small aquarium pump powers a simple pumping mechanism which delivers nutrients from the reservoir up to the top of the growth chamber, where it trickles back down through the root zone and into the reservoir. This system is so effective it is not uncommon for tomato plants to grow over 4 inches per day! This system gives huge yields! I HIGHLY recommend this unit for the first time hydroponic grower.

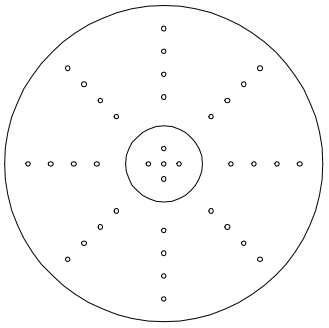
Parts List to make one “Aquafarm”

Item	Cost	Notes
1 ea. 5 gallon bucket	$4.00	Get this at just about any hardware store or scrounge it - they are everywhere. Make sure you use a “standard” pail. See the detail drawings .
1 ea 3.5 gallon bucket	$4.00- 6.00	This is the most difficult part to find. This bucket is the same diameter as the 5 gallon size but several inches shorter. The criteria for this bucket is that it nests inside the 5 gallon bucket. See detail drawings.
1 ea. ½" rubber grommet	$0.69	You’ll find this item in the electrical supply part of your hardware store. The ½" measurement refers to the inside diameter of the rubber grommet. See the detail drawings.
1 ea. 14" long piece of schedule 125 or 200 ½" dia. PVC pipe	$0.60 per ten feet	You’ll find this near the sprinkler supply stuff in the plumbing section of the hardware store.
1 ea. 14" long white polyethylene tubing. 3/8" Outside diameter, 1/4" Inside diameter	$0.10 per foot	Once again, you’ll find this in the plumbing section of your hardware store. The white polyethylene tubing is not a must, but it works the best (I have used 3/8" O.D. clear aquarium tubing). What is most important is the outside diameter, it must be small enough to fit inside the “tee”. Secondly an inside diameter of 1/4" makes the pump perform best. The pump I made with the aquarium tubing (which had a larger inside diameter) did not perform as well.
1 ea. 15" long, 5/16" outside diameter vinyl tubing	$0.10 - $0.20 per foot	Plumbing section, right next to the poly tubing. Once again, you just have to get close. The important qualities of this part are first, the outside diameter of the tubing and secondly flexibility. 5/16" tubing makes a nice snug fit into the “tee”, unfortunately this size tubing is not common. You can use 3/8" O.D. tubing and wrap it with tape to make a tight fit into the “tee”. The tubing must be flexible enough to be bent into a ring without kinking.
1 ea. ½" Raindrip barbed “tee”	$0.55	Raindrip is a popular brand of drip irrigation product. You should be able to find this in the sprinkler section of you local hardware store. If you cannot find this part you can order it from one of the suppliers that I have listed. Also you may study the detail drawing that I have provided and make a substitution.
1 ea. ½" Raindrip barbed elbow	$0.55	Same thing as above, but an elbow.
1 ea. 10" long ½" I.D. tubing	$0.40 per foot	You’ll need to find a transparent tubing as this is used to indicate the level of solution in the reservoir.
1 ea. 16" long 3/16" O.D. aquarium air tubing	$0.80 per 3 feet	You’ll find this at the pet store, one three foot length will make two pump columns.
1 length of 3/16" I.D. aquarium pump tubing	$0.20 per foot	Pet store

1 small aquarium pump	$3.00 to $40.00	You can use any size aquarium pump. I have successfully used the smallest $3.00 cheapo pump. Although, I do recommend buying a pump a few notches up from bottom of the line. The small pumps provide enough air to run the system but they only last for about a year and they usually start humming after a few months. Another benefit to buying a larger air pump - the increased output is enough to run more that one Aquafarm. I have powered up to six aquafarms on one “mega” 30 dollar aquarium pump.

Assembly Instructions

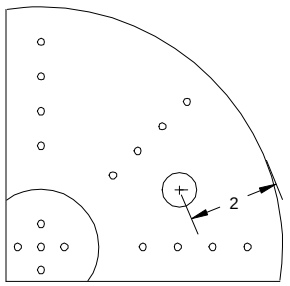
1. Remove the handles from the buckets.

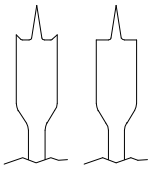


Bottom View of 3.5 gallon bucket.

2. Drill drainage holes in the bottom of the 3.5 gallon bucket. The size of the drainage holes is not critical, just keep them small enough to keep your growing medium from falling into the nutrient reservoir. I usually drill holes somewhere around 5/32" in diameter. Also, be sure to drill enough holes for adequate drainage. I usually drill about 30 to 40 holes in a pattern similar to the one pictured to the right.

3. Drill the pump column hole in the bottom of the 3.5 gallon bucket. Use a 13/16" diameter spade drill bit to do this. Drill this hole approximately two inches away from the outer edge of the bucket. Refer to the drawing at right for placement.

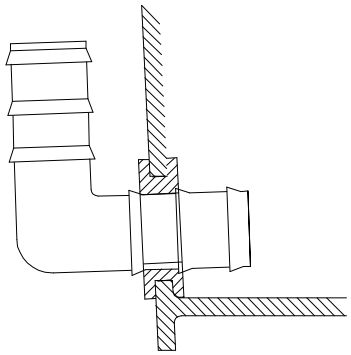




A B

Pictured at left you will see a diagram of the two types of spade bit available. Bit "A" has pointed outer teeth where bit "B" does not. I have found that type "A" works far better for drilling holes in plastic pails. The two outer teeth cut through the thickness of the pail before the main cutter engages. This makes for an easy cut resulting in a perfectly circular hole with no irregularities. Finally, when drilling the hole proceed with light pressure and, if you have a variable speed drill, a slow drill speed. Be ready to stop the drill as you break through the bucket, if you continue to drill after you have pierced the bucket, the bit will rattle in the hole and "hog" it out into a larger, triangular shaped hole. A perfect hole in the 5 gallon bucket is necessary for the grommet to seal properly, so it pays to practice here where it really doesn't count.

4. Drill the grommet hole in the side of the five gallon bucket. Drill this hole on the side of the bucket as close to the bottom as possible. Be careful not to pierce the bottom web of the bucket. Unfortunately I can't give you the exact size of the hole to drill because there are several types of rubber grommets which vary slightly in size. You will need to measure your grommet and determine what size hole to drill (this should be in the ballpark of 3/4" or 13/16"). I suggest that you drill a test hole in something other than your bucket and check the fit of the grommet. The diagram at right shows the 5 gallon bucket with the hole drilled, the rubber grommet fitted and the elbow pressed into place.

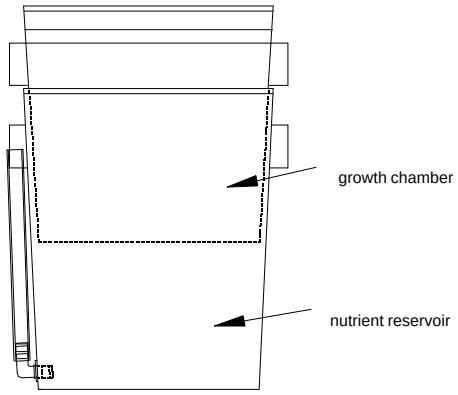


5. Insert the rubber grommet into the 5 gallon bucket. It is important that the grommet forms a water tight seal with the bucket, so you may have to remove any burrs left from the drilling process with a utility knife.

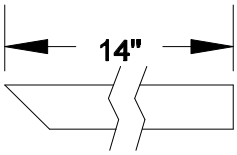
6. Insert the elbow into the rubber grommet. When you press the elbow into the grommet hold your hand on the grommets' back side to keep it from pushing through into the bucket. Insert the elbow about half way into the grommet so that is still has room to swivel. When you're done with this step you should have something that looks like the drawing above.

7. Attach the 10" long, ½" I.D. tube to the elbow. Attach this tubing to the part of the elbow on the outside of the bucket. This tubing will serve to indicate the level of nutrient in the Aquafarm. When it's time to change the solution it also acts as a drain, you simply swivel it down and let the solution drain out!

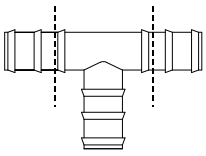
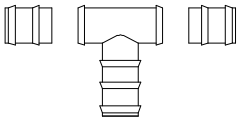
8. Insert the 3.5 gallon bucket into the 5 gallon bucket. At this point you have completed the body of the Aquafarm and you should have something that looks like the drawing at right.



9. Cut the pump column support tube. Following the diagram at right, cut the ½" pvc pipe to 14" in length measuring from the tip of the bevel. Make the cut at approximately 45 degrees.

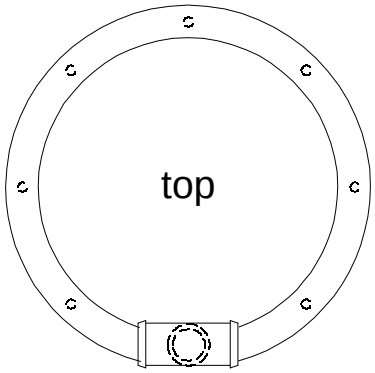


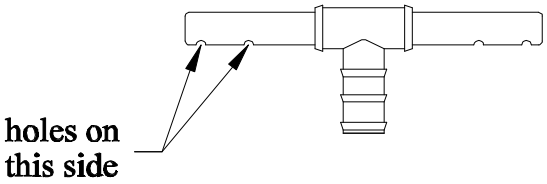
10. Insert the pump column support tube (from previous step) into it's hole (from step 3) in the bottom of the 3.5 gallon bucket. Insert it beveled end first and push it all the way in, until it bottoms out in the nutrient reservoir.

11. Cut the  **tee**  **as shown.** A small hacksaw works best. Discard the two small pieces.

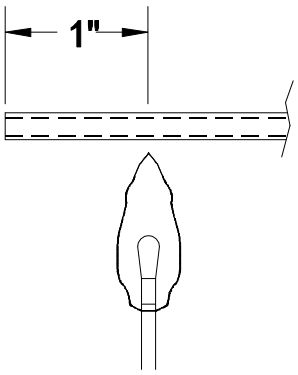
12. Cut and drill the drip ring. Cut the 5/16" O.D. tubing to 15 inches long and drill seven 1/8" diameter holes equally spaced along its length (refer to the diagrams below).

13. Insert the drip ring into the "tee". Press the ends of the tubing into the cut ends of the "tee". Make sure the holes in the tubing point towards the stem of the "tee". Set this aside for later.

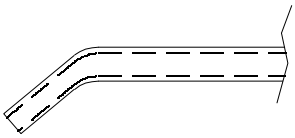




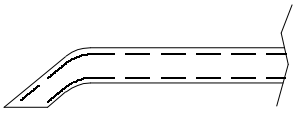
14. Heat the 3/16" aquarium tubing. Heat the tubing about 1" from the end until it is soft enough to bend. Rotate it just over the tip of a flame so it is evenly heated, just a few seconds will do the trick.



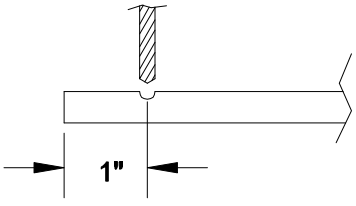
15. Bend the tubing. Make the bend to just a little less than 45 degrees. It is important that you do not kink the tubing as air must flow through it.

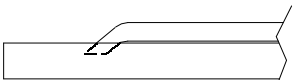


16. Trim the tubing. Bevel the end of the tubing as shown. The length of the bent portion of the tubing should be about 1/4" long.

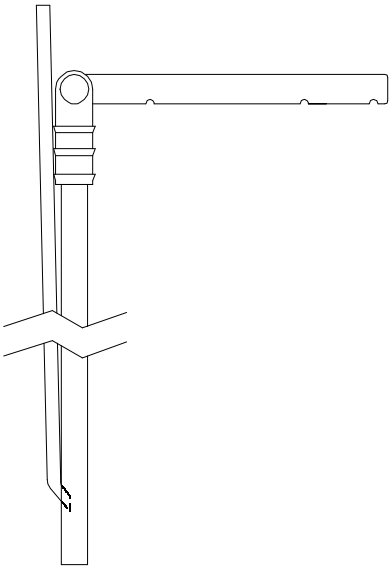


17. Drill the hole in the 3/8" O.D. pump column tube. Drill a 3/16" diameter hole in the side of the pump column tube, approximately 1 inch from the end.



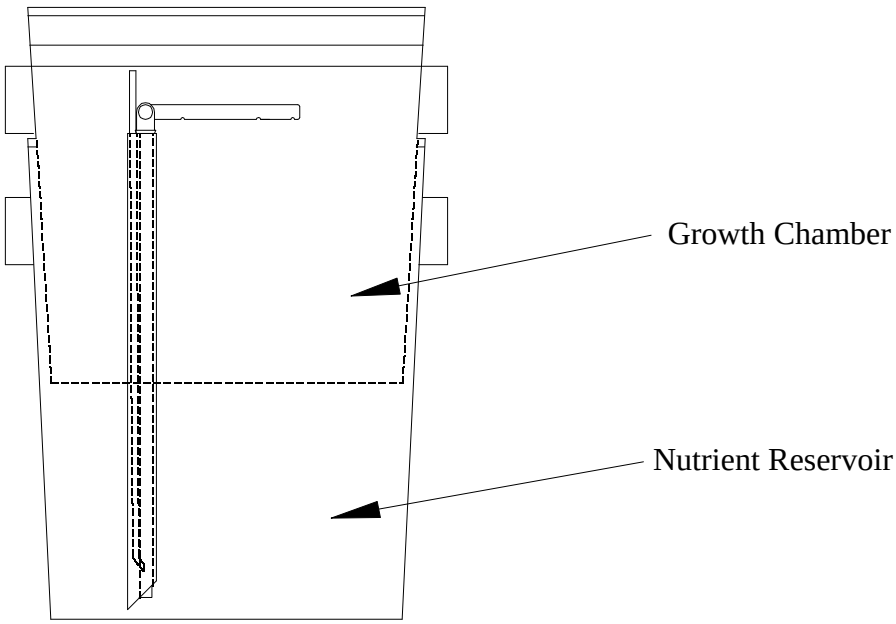


18. Assemble the pump column. Insert the bent end of the 3/16" aquarium tubing into the hole in the pump column tube. Seal the joint with a non water soluble glue. Hot glue is wonderful, but something like epoxy works too. Spot glue the aquarium tube to the pump column tube in several places too.



19. Attach the pump column to the drip ring. Slip the drip ring over the pump column, don't glue it. Voila! You've completed the pump column!

20. Final step. Insert the pump column assembly into the pvc support tube. You should now have something like the drawing below. Congratulations on completing you first "aquafarm".



How to use your hydroponic unit.

Now comes the fun part!
Growing

First you need to select a growing medium. There are a whole host of different mediums that have been used over time. They include rockwool, sawdust, peat, pearlite, vermiculite, sand, gravel, and various inert mixtures. You could probably use most of these mediums successfully in this system but let me boil it down to two choices for you - pearlite and expanded clay pellets (baypour, grow rocks, geolite). Pearlite it great because it's dirt cheap, about 10 dollars for 4 cubic feet. That will fill over nine systems! Once your crop is done you can just throw it away and start with fresh pearlite. You don't have to worry about cleaning and sterilizing your medium. The clay pellets perform well too, they are THE choice for commercial hydroponic farmers in Holland (the land of hydroponics and greenhouses). They last quite a long time and they are guaranteed to not affect your nutrient balance. The drawback to using the expanded clay is that it is expensive. They run 10 dollars for 3.5 gallons - that's nine times more expensive! Since you'll not be discarding the clay pellets I recommend using them for long term crops.

Now that you have your medium in hand, along with your plants and your newly made "Aquafarm", we're ready to have fun. First off, the reason that we didn't glue the drip ring onto the pump column is so we could take it off and get it out of our way when we fill the growing chamber with medium and plants! So.....pop that sucker off now! Next, fill the growing chamber with your medium. Make sure not to fill it any higher that the level of the drip ring. You may adjust the level of the pump column and drip ring by moving the pvc support tube up and down (ahaaaa!!....that's why it fit so tightly in the hole) as necessary. If you are using pearlite I suggest that you pre-wet it with plain old water. Give it a pretty good soaking with a hose and let the excess water drain off (be sure to dump the excess water out of the nutrient reservoir).

If you are transplanting from soil, gently wash as much of the soil out of the root ball as possible. It is not necessary to remove all of the soil, just as much as possible without mauling the root system. If you have started your plants in rockwool cubes, vegetable plugs or peat pellets just plant the whole thing.

Next, find that drip ring and hold in its place for a second. Use the exact science of guessing and get an idea of where the center of the ring is in relation to the bucket. Put the drip ring down and dig a hole wherever you determined the center to be. Gently place your plant into the hole, evenly distributing its roots. Backfill the whole. Find that drip ring again. Unplug one end of the ring from the tee. Put the ring back onto the pump column, wrap the ring around the stem of the plant, and plug it back into the tee.

Finally, fill the reservoir with 2.5 gallons of nutrient solution. Just slowly pour it right into the growing chamber. Connect the aquarium pump to the 3/16" tube on the pump column and plug the pump in. The column should immediately start pumping nutrient up out of the reservoir and drip it around the base of the plant. It is best that you use a simple light timer to turn the pump on during daylight hours and off during the night time.

Happy Hydroponic Gardening!

A note about nutrients.....

I strongly recommend the use of the General Hydroponics line of nutrients. GH is considered to be the best nutrient manufacturer by the hydroponic community. So good that the USDA, the EPA and NASA uses them. They make four different lines of nutrient, ranging from a "beginner-no-brainer" one part powder to a three part liquid system (can you say "turbo charge your plants"?).

Suppliers

3.5 gallon buckets	General Hydroponics GreenFire McMaster Carr (Item # 3995T32)
Rubber Grommets	General Hydroponics GreenFire Mcmaster Carr (Item # 9600K22
Raindrip barbed tee's and elbows	General Hydroponics GreenFire Raindrip
Complete pump columns	General Hydroponics GreenFire
Complete drip rings	General Hydroponics Greenfire
General Hydroponics nutrients	General Hydroponics GreenFire
Compete systems	General Hydroponics GreenFire

General Hydroponics
P.O. Box 1576
Sebastopol CA 95473
707-824-9376
Internet: www.genhydro.com
email: genhydro@monitor.net

McMaster Carr Supply Company
P.O. Box 54960
Los Angeles, CA 90054
310-692-5911

Raindrip
805-581-3344

GreenFire
347 Nord Ave. #1
Chico, CA 95926
916-895-8301

Greenfire #2
3230 Auburn Blvd.
Sacramento, CA 95821
916-485-8023