Hydroponic Drip Garden for Vegetables, Herbs or Flowers

by dirty_valentine on March 28, 2009

Table of Contents

Intro: Hydroponic Drip Garden for Vegetables, Herbs or Flowers

The picture below shows the two hydroponic drip systems I built that are covered by this instructable. The prototype system was built about 3 weeks prior to the taking of the picture. All the plants currently residing in the prototype are between 1 and 2 1/2 weeks old. The prototype has been working so well I build a second system for plant staging. This instructable chronicles the construction of the second system, **as well as growing progress updates in Step 15.**

How the System Works

The hydroponic nutrients are stored in the black plastic box. A water pump inside the box pumps the nutrients up to the drip lines at the top, thus providing nutrient solution to the grow media (clay balls in my case) and plants inside the white plastic pots. The nutrients will drain out the bottom of the plastic pots which is then collected by the recessed yellow lid that the pots sit on. Holes in the lid allow the nutrients to drain back into the black plastic box. I currently have a timer that waters the plants for 15 minutes every hour that the light is on, and then twice more during the night.

Hydroponic Systems; What is best for you?

I have been using two basic hydroponic systems: Raft and Drip. Other hydroponic systems include: Ebb and Flow, Nutrient Film, Aeroponic and Fog.
The raft system works by floating the plants right on top of the nutrient solution. An air pump and air stone are used to aerate the nutrients. The raft system is really good for growing lettuce but most plants thrive better without their roots submerged right in the nutrients.
The drip system works in much the same way that plants normally get watered. Nutrients are provided to the top of the grow media by gravity or a pump which draws much needed oxygen into the media as the nutrients drain out. This method should work well for almost any type of plant. Pump failure and cloged drip lines are the down side of this method.
The Ebb and Flow system is a popular system for home hydroponics. Pots are placed in a tub that is flooded with a couple inches of nutrients using a water pump. This waters the pots from the bottom up. After the tub is flooded, the pump is turned off and the tub drains back into the nutrient reservoir. One downside of this type of system is you need a large reservoir to hold all the nutrients necessary for flooding the tub as well as enough left over so the pump does not run dry. Like the drip system you also have the possibility of pump failure.
The Nutrient Film system works by placing the plant roots on a thin layer of flowing nutrients. From what I have read, these systems are hard to set up and thus not a good place to start for the home hydroponic enthusiast.
The Aeroponic and Fog systems work by atomizing the nutrients which the roots are sprayed with, or suspended in. This can be a very powerful method for growing plants as the atomized solution contains much oxygen, which the roots thrive in. Most of the home bought systems labeled as "Aeroponic" are not really aeroponic system though. These home systems use small fountain pumps and spray nozzles to spray the bottom of net cups and roots. The tiny fountain pumps cannot produce the kind of pressure necessary to atomize the nutrient solution so the gain over a drip or ebb and flow system are questionable. I have avoided these systems as the tiny spray nozzles seem more likely to clog than the larger drip emitters. Fog systems are fairly new and I do not know about the reliability or availability of these systems for the home hydroponic enthusiast.

Image Notes
1. Prototype hydroponic drip garden (with plants growing in it)
2. New hydroponic drip garden (constructed for this instructable)

Step 1: Materials Needed

Here are the items you will need:
1 - 27 gallon heavy duty plastic storage box with recessed plastic lid
10' of 1/2" PVC pipe
5 - 90 deg PVC elbows
3 - PVC T connectors
1 - 3/4" to 1/2" PVC reducer
1 - 3/4" PCV pipe to 3/4" Male Thread connector
4 - 1/2" PVC J-Hook Hangers
1 - Male Quick Disconnect to male 3/4" hose thread
1 - Female Quick Disconnect to female 3/4" hose thread
1 - 1/2" hose barb to female 3/4" hose thread
1 - rubber washer with filter screen
3' of 1/2" flexible rubber hose
1 - Active Aqua PU160 water pump
12' 1/4' O.D. drip line hose
12 - Drip stakes or drip nozzles with tie down stakes
12 - Square Plastic pots sized to fit 3 across top of tote lid
1 - 24 Hr timer with 15 minute on/off timing intervals

The first 11 items on the list were all purchased from Home Depot and can be picked up at most hardware stores. The remaining item were purchased from a local hydroponics store in Billerica MA [www.greenlifegardensupply.com]. I highly recommend them if you are local; If not most items can be picked up via the WEB or at a local garden supply shop. I purchased everything new for a total cost of about $70.

Tools Needed
Miter box and miter saw or hack saw for cutting PVC
Sand paper, small round file, or deburring tool to debur cut PVC
PVC purple primer and cement adhesive
Electric Drill with assorted bits
1" speedbor bit or 1" hole saw
Awl or Nail to place drill starting mark in PVC
Utility knife

Hydroponic Supplies Needed
Your choice of hydroponic nutrients (I'm using Botanicare Pure Blend Pro)
Your choice of grow media (I used about 15 liters of clay balls)

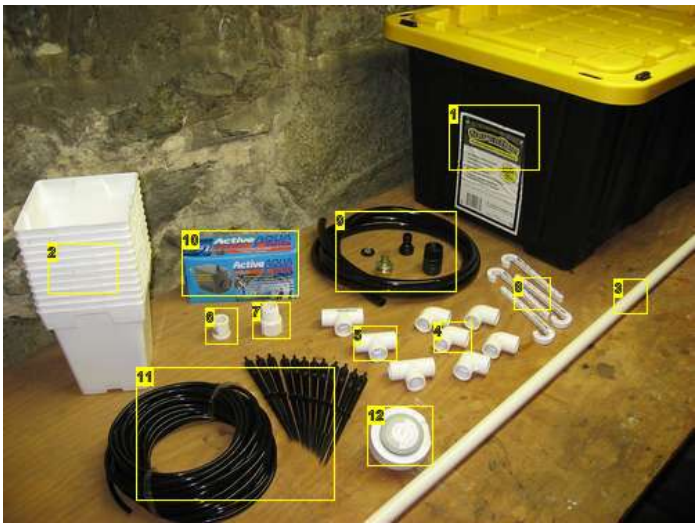


Image Notes
1. 27 Gallon plastic tote with recessed plastic lid
2. 12 Square plastic pots
3. 10' of 1/2" PVC pipe
4. 5 - 90 deg PVC elbows
5. 3 - PVC T connectors
6. 3/4" to 1/2" PVC reducer
7. 3/4" PCV pipe to 3/4" Male Thread connector
8. 4 - 1/2" PVC J-Hook Hangers
9. 3' of 1/2 flexible hose, Male Quick Disconnect to male 3/4" hose thread, Female Quick Disconnect to female 3/4" hose thread, 1/2" hose barb to female 3/4" hose thread, rubber washer with filter screen.
10. Active Aqua PU160 water pump
11. 12' 1/4' O.D. drip line hose and 12 drip stakes.
12. 24 Hr timer with 15 minute on/off timing intervals.

Step 2: Box Setup

The lid of the plastic box needs to be solid enough to support the weight of the pots and plants without significant bowing. The lid must also be recessed to capture the nutrient solution as it drains from the pots. Drain holes in the lid will then allow the nutrients to drain back into the box. Heavy duty stacking storage boxes like this can be found most large hardware stores.

You will want to select square pots that will set flat 3 across the recessed part of the plastic lid (see first photo). You should also be able to get 4 pots along the length of the lid as well as a 1" space between each half dozen pots (see second photo). As you can see from the photos the pots I selected are a good fit.

Measure from the top outside edge to top outside edge of 2 pots lined up side by side, as well as 3 pots lined up side by side. the yellow note boxes in the second photo indicate the measurements to be made.

In my case 2 pots measure about 10 3/4" and 3 pots measure about 16".

With these measurements in hand, let's get to cutting.

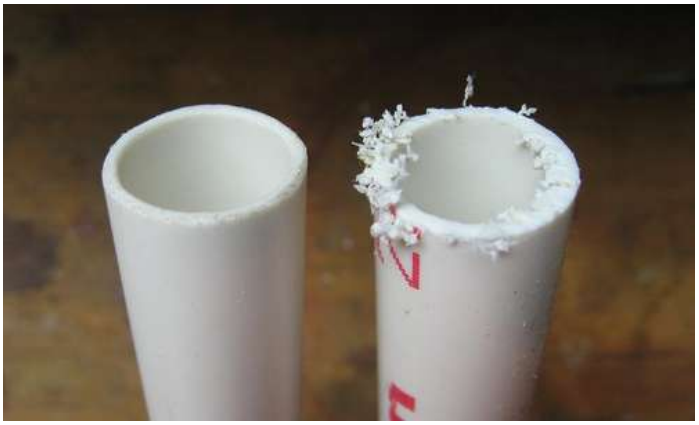
Image Notes
1. Measure from outside edge to outside edge of 3 pots lined up side by side.
2. Measure from outside edge to outside edge of 2 pots lined up side by side.

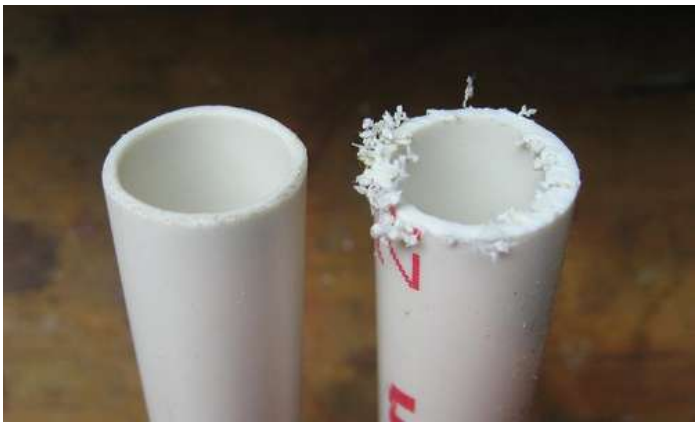
Step 3: Cutting the PVC Pipe

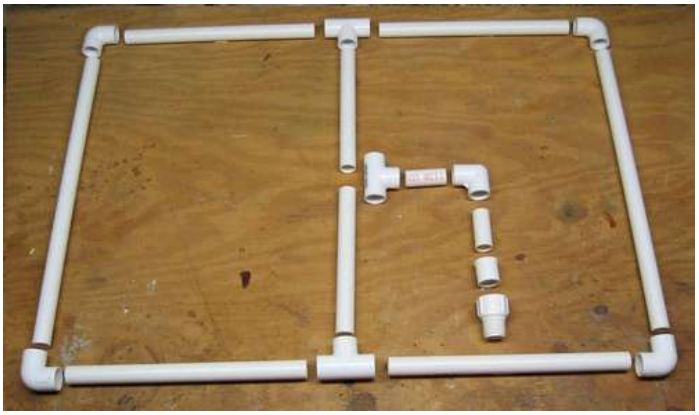
Now take your 1/2" PVC pipe and cut the following pieces:
2 - The length of three pots + 1/4"
(in my case that is 16" + 1/4" = 16 1/4" total)
4 - The length of two pots + 1/4"
(in my case that is 10 3/4" + 1/4" = 11" total)
2 - one half the length of three pots - 3/4"
(In my case that is (16 - 3/4") / 2 = 7 5/8". Sorry about the math)
2 - 2" long pieces

I used my cheap plastic miter box and saw to cut the PVC (first photo). You can use a hack saw without the miter box, but I like how the miter box squares up the ends. Once you have all the pieces cut, use some sand paper, a small round file, or deburring tool to remove the plastic burrs left over from cutting (second photo). Make sure you blow out any loose plastic bits once you are done deburring as they can clog the drip lines.

The cut PVC pieces as well as the PVC fittings are shown in the last photo in their final positions prior to assembly.





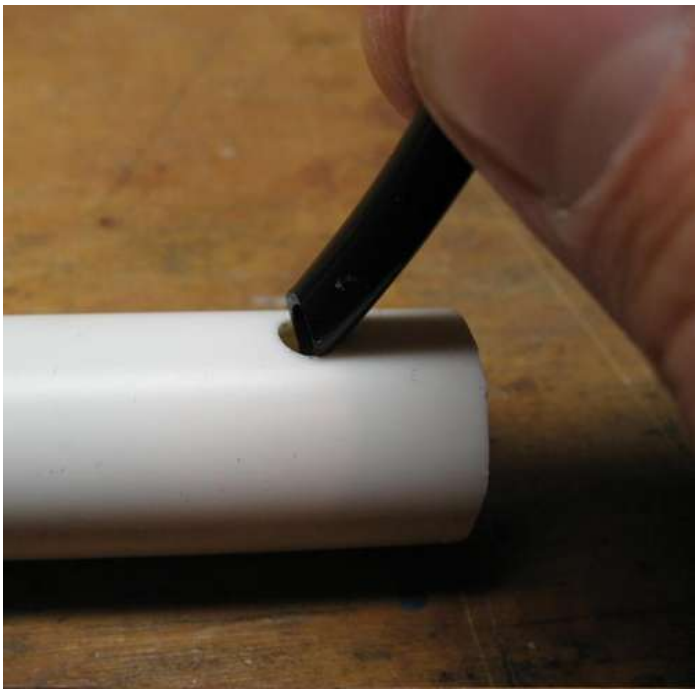


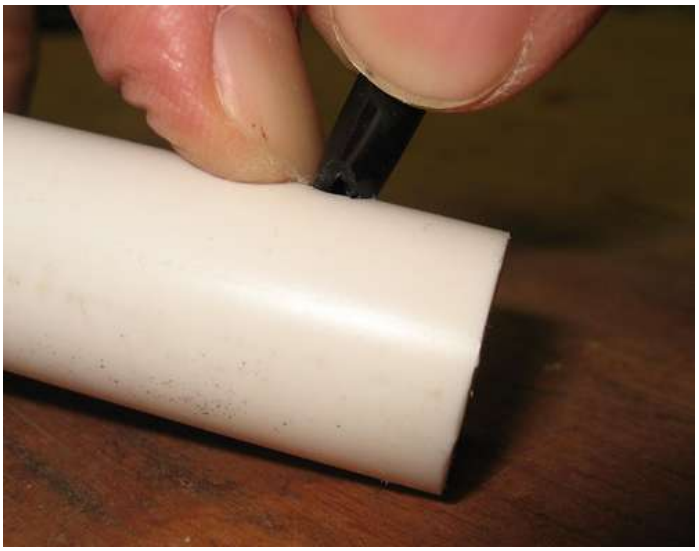
Step 4: Drill Selection for Drip Line

Select a drill bit one size smaller than the outer diameter (O.D.) of the drip line. My drip line was 1/4" O.D. so I selected a 7/32" drill bit. Take a piece of the left over 1/2" PVC (not one of the pieces you cut in the last step!) and drill a hole in he side of the PVC using the 7/32" drill bit. Remove any plastic burrs with a utility knife (be careful not to cut yourself). Only cut at the surface as you do not want to change the hole diameter.

Take a small piece of the drip line tubing and cut the end of the tube at a 45 degree angle. Now try to insert the end of the drip tube in the hole you drilled. You should find that the hole is smaller than the tubing and the tubing does not want to go in (see second photo). If it does slide in, you will need to select a smaller drill bit.

To get the tube into the hole I found I could place my thumb nail against the tubing with one hand, while I grasped the tubing with the other hand, then I pushed and twisted the tubing back and forth. The inserted tubing made a nice pressure fitting that does no leak. If you can not get the tubing in, try soaking about 1/4" of the drip tubing end briefly in hot tap water. this will soften the tubing and should make it easier to insert. If you still can't get the tubing in, you may have to go up a drill size. In the end you want as tight a fit as you can get though.





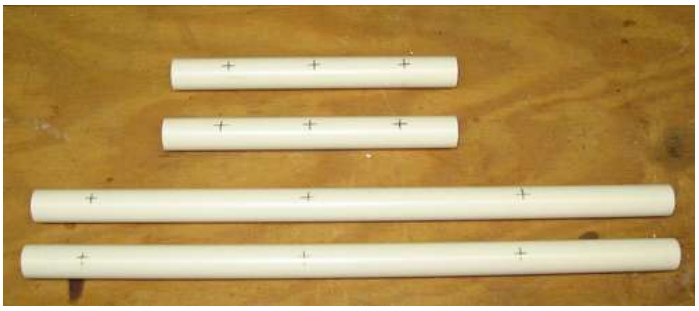
Step 5: Drilling Drip Line Holes

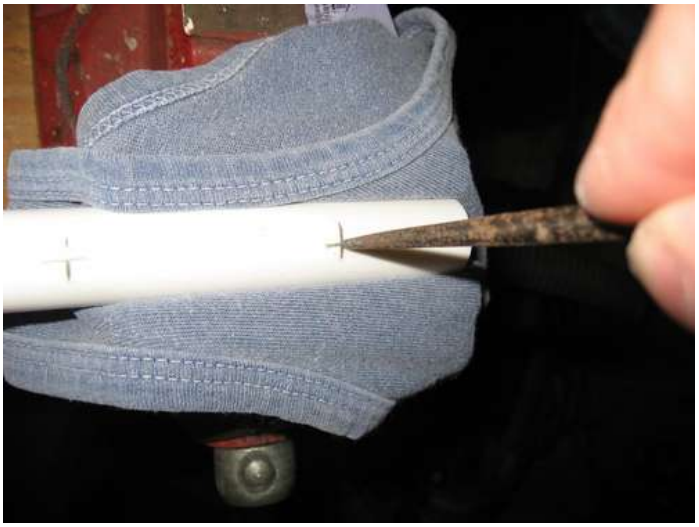
Take the two longest pipe pieces (16 1/4" in my case) and place a mark 1 1/2" from one end of both pieces. Now make a second mark further down the same side of the PVC pipe the exact width of the top of one of the pots. In my case the width of the top of one of the pots was about 5 1/3". Now make a third mark further down the same side of the PVC pipe again the width of the top of one of the pots. The marks on the long pieces should look similar to the first photo.

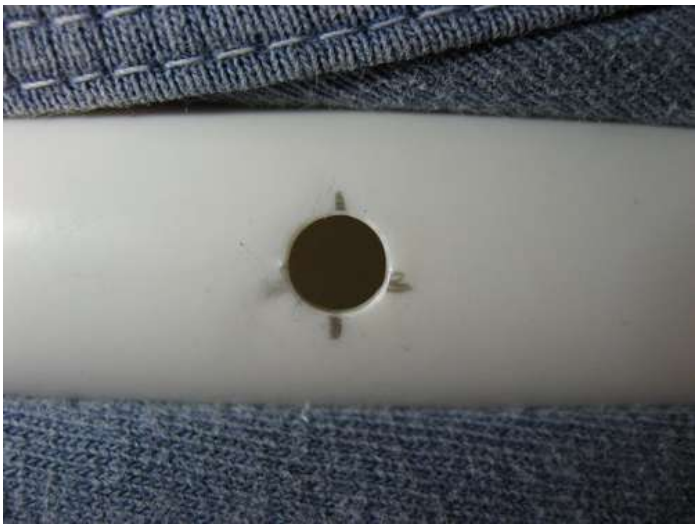
Now take the two shorter PVC pieces (7 5/8" pieces in my case) and place marks 1 1/2" from both ends of both pieces on the same side. Once you have done that place one more mark half way between the two end marks. The location of the marks should look similar to those in the first photo.

A vice clamp can be handy at this point. Open the jaws slightly more than the width of the PVC tube. Lay an old t-shirt over the clamp jaws and press the PVC tubing down into the clamp jaws as shown in the second photo. tighten the clamp just enough to hold the PVC tubing (you don't want to crack it). Now use an awl or nail to indent the PVC tube at one of the marks (see third photo). Using the drill bit found in the last step, drill through one side of the PVC tube (do not drill through the back side of the PVC tube or you will have a leak on your hands!). Repeat these steps for all 12 marks.

Finally, use a utility knife to remove any plastic burrs left over from the drilling. As in the last step, remove only surface material and do not deform the hole size (see last photo). Make sure you remove any loose PVC material as it can plug the drip lines.







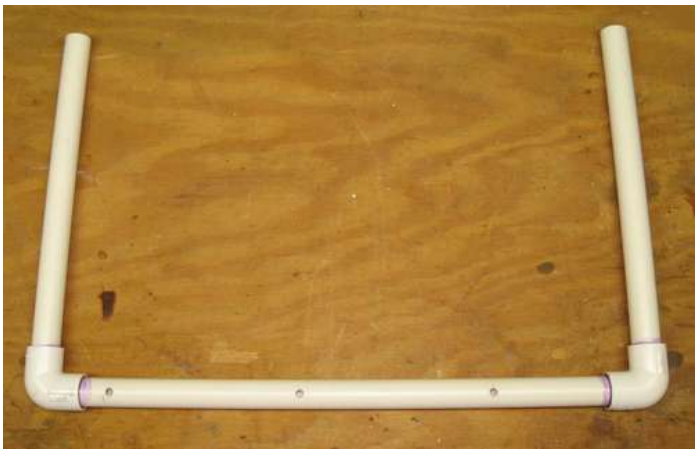
Step 6: Assemble PVC sides

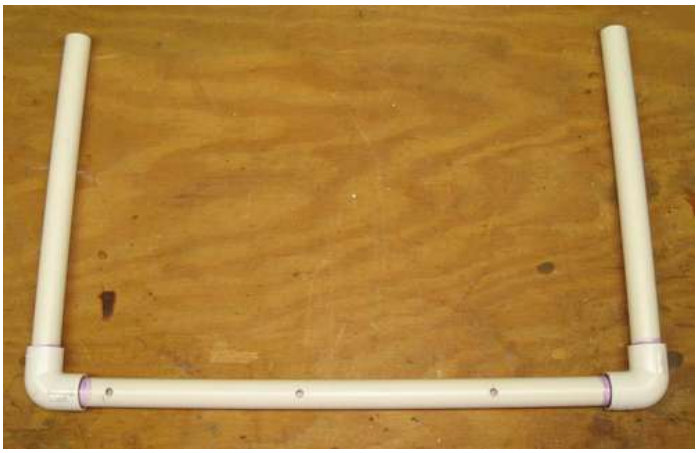
NOTE: Purple primer and PVC cement are used to attach all PVC fittings to the PVC pipes. If you have not done this before it is fairly simple. Just read and follow the the instructions and safety precautions on the cans.

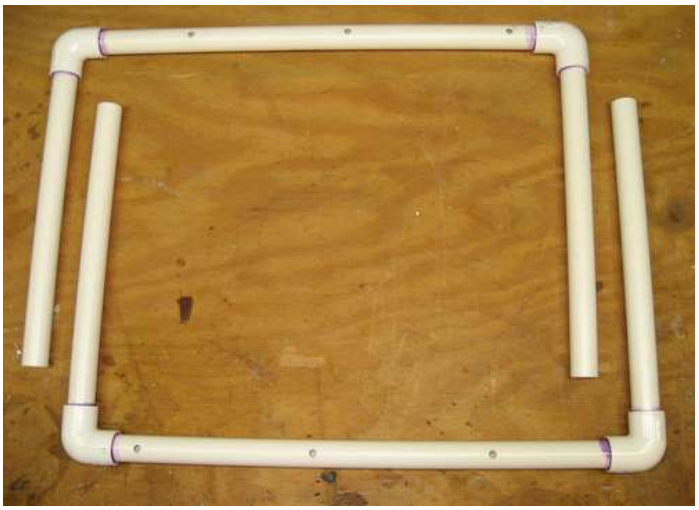
Attach a 90 deg PVC elbow to the end of each of the 4 mid-sized pieces without drill holes (First photo). Once the fittings are attached, allow the cement to cure for a couple minutes before proceeding.

The second photo shows how to attach two of the pieces assembled in the first photo to one of the long PVC pipes with drill holes. Assemble one side at a time. While assembling the first side make sure that the drill holes point strait up, away from work surface shown in the second photo. Allow a couple minutes for the joint to cure. Then join the second elbow to the long pipe. While holding the joint in place, quickly press the whole assembled unit down on a flat work surface before the cement dries. Both elbows as well as the two open pipe ends should touch the work surface as shown in the third photo. If they don't all touch your final PVC assembly will be cocked.

Use the same procedure above with the remaining two pieces assembled in the first photo with the remaining long PVC pipe with drill holes. Once complete the two assembled pieces should look like the fourth photo.







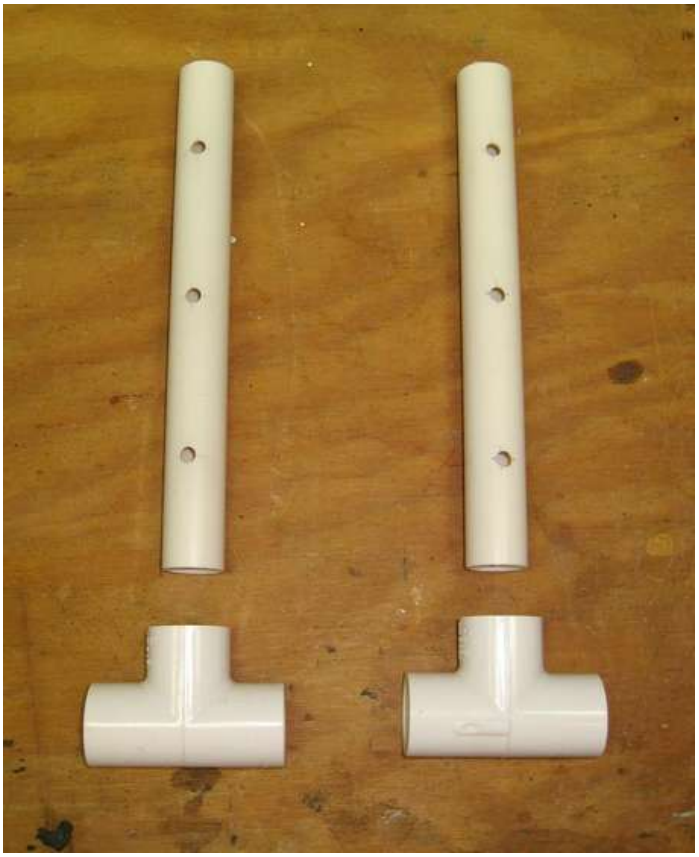
Step 7: Assemble PVC middle

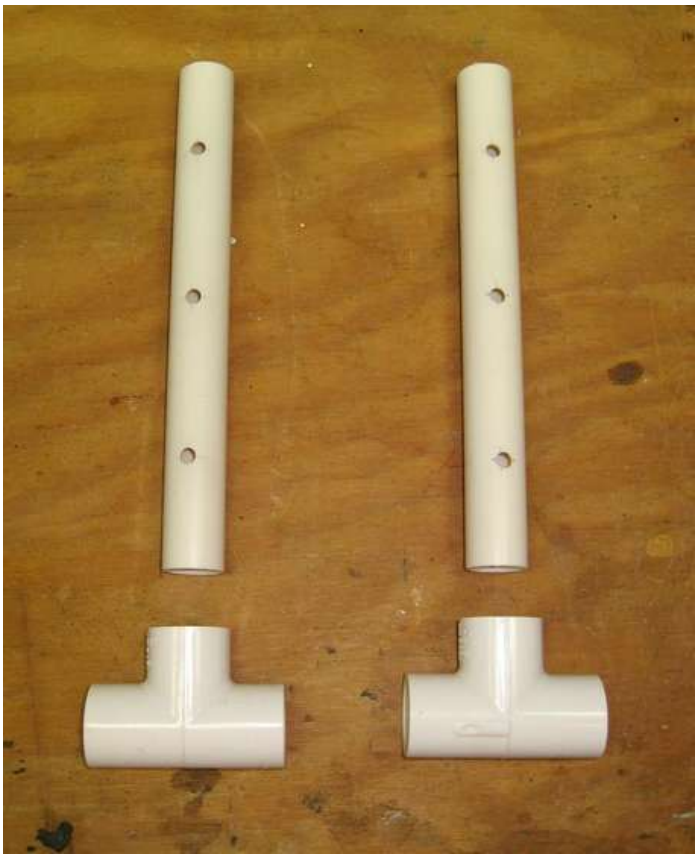
NOTE: Purple primer and PVC cement are used to attach all PVC fittings to the PVC pipes. If you have not done this before it is fairly simple. Just read and follow the the instructions and safety precautions on the cans.

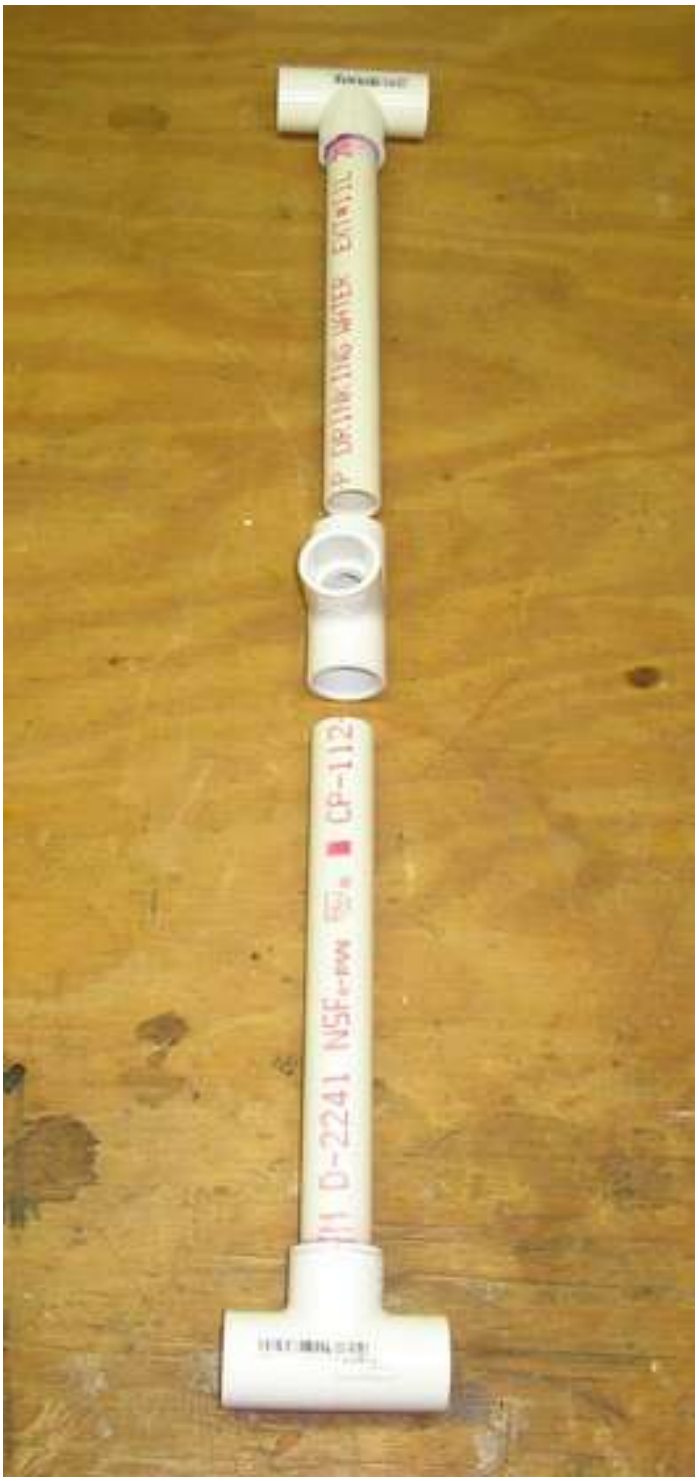
Attach one of the PCV T-fittings to the end of one of the shorter PVC pipes with drill holes. Orient as shown in the first photo with the T-fitting flat on the work surface, and the drill holes pointing straight up from the work surface. Repeat this procedure for the other short PCV pipe with drill holes and a second T-fitting.

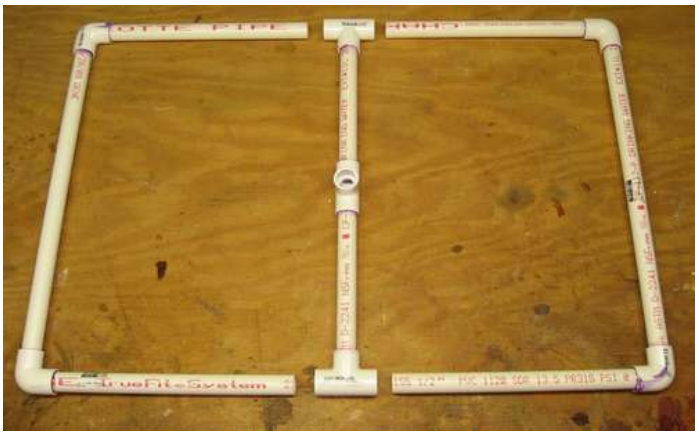
The second photo shows the orientation of the two units just assembled with a third T-fitting. Note that the holes in the PVC pipe are not seen as they are facing the work surface. Attach the T-fitting in the middle to one of the assembled short pipes. Be sure to orient the T-fitting so that it is pointing straight up from the work surface down, while the drill holes face straight down into the work surface. Allow the joint to cure for a couple minutes. Now attach the other end of the T-fitting to the remain short pipe end. While holding the joint in place, quickly press the whole assembled unit down on a flat work surface before the cement dries. Both end T-fittings should lie flat on the work surface with drill holes all facing the work surface as shown in the third photo.

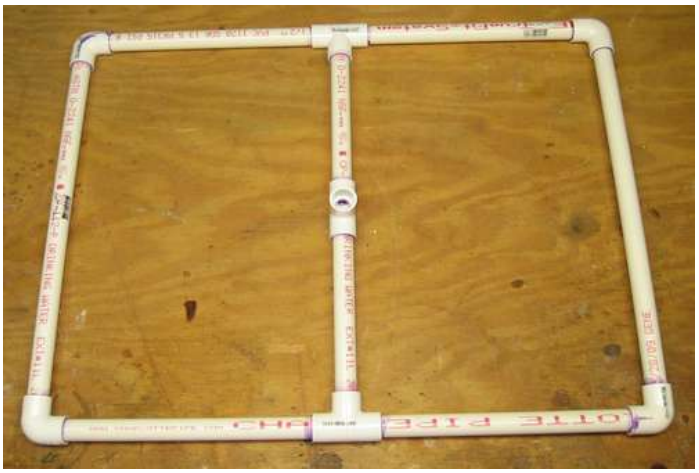
The orientation of the two sides with respect to the middle assembly is shown in the third photo. Note that all drill holes face the work surface. Assemble one joint at a time and allow the joint to cure before moving onto the next joint. Also be sure to press each assembly down on the work before the cement dries to keep the entire assembled unit flat. The PVC will flex enough to allow primer and cement to be applied before closing each rectangle. Final assembly is shown in the fourth photo.






D-2241 NSF-pw CP-112





Step 8: Final PVC Assembly

NOTE: Purple primer and PVC cement are used to attach all PVC fittings to the PVC pipes. If you have not done this before it is fairly simple. Just read and follow the the instructions and safety precautions on the cans.

The orientation of the final PVC fittings and remaining 2" pipe pieces is shown in the first photo. The assembly order is not important. Just start at one end and work your way to the other. Once everything is assembled it should look like the second photo.

Finally attach the 1/2" pipe end of the assembled unit to the T-fitting of the final unit assemble in the last step. The last photo shows the orientation of the two assemblies.

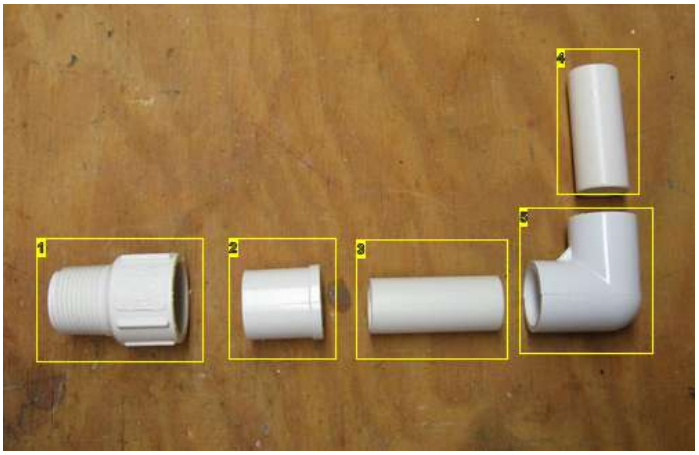
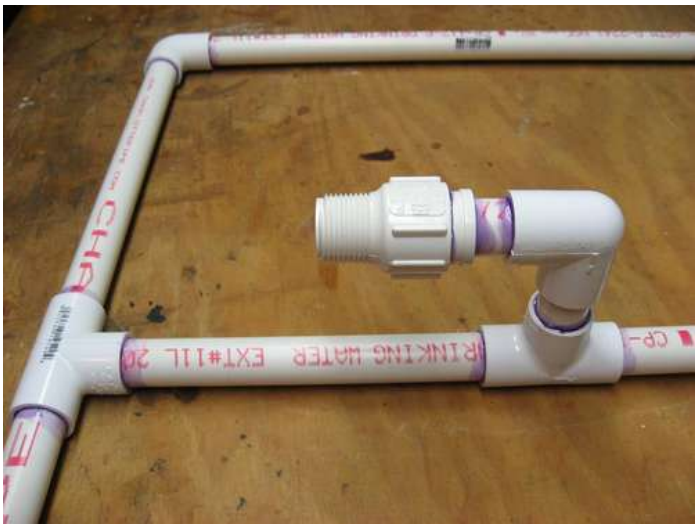


Image Notes
1. 3/4" male thread to 3/4" pipe
2. 3/4" to 1/2" PVC reducer
3. 1/2" PVC pipe, 2" long
4. 1/2" PVC pipe, 2" long
5. 1/2" 90 deg elbow



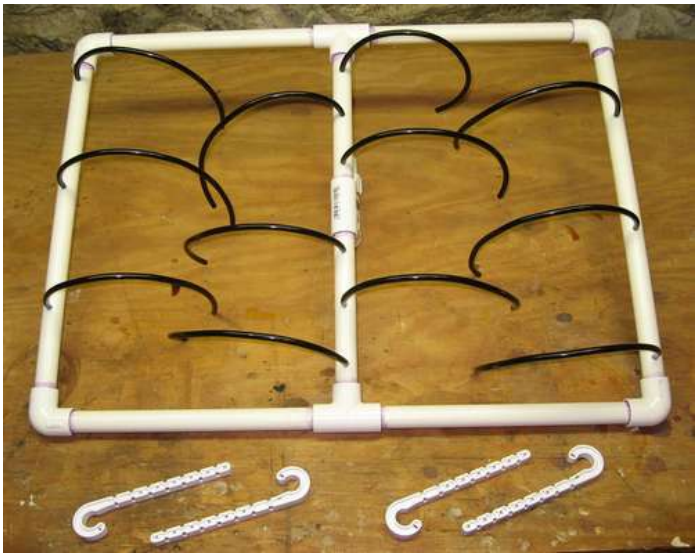
Step 9: Adding Drip Lines and Legs

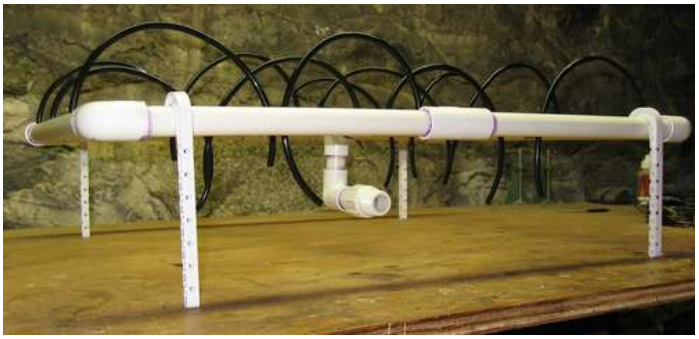
Using the utility knife or scissors, cut 12 - 12" long pieces of the drip tubing. One end of each tube should be cut at a 45 degree angle for insertion into the PVC holes. Insert a drip tube into each of the 12 drill holes using the same method as in step 4. The first photo shows the PVC assembly with drip tubes installed.

Clip a 1/2" PVC J-hook hanger about 1" from each of the 90 degree elbows as shown in the second and third photos. It was very difficult to snap on the j-hooks, but once on they made nice legs for the assembly.

The j-hook legs should stand evenly on the plastic lid. Optimally the legs are placed to stand in a recessed area of the lid to hold the assembly in place (See last photo).

I did not glue the j-hooks in place but you could if you wanted to make sure they did not come off.





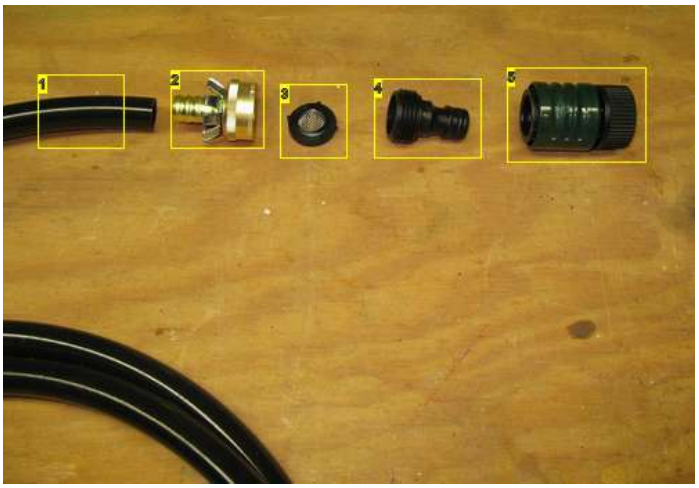
Step 10: Hose Assembly

The first photo shows the hose assembly pieces.

Insert the 1/2" hose barb into the 1/2" flexible hose and attach as instructed. If the female 3/4" hose thread end came with a rubber washer, remove it and insert the rubber washer with filter screen as shown in the second photo. The filter screen will help to trap particles that could plug the drip lines. You should check and clean the filter screen as necessary. Now screw the Male Quick Disconnect into the female hose thread as shown in the third photo.

If your female quick disconnect to female 3/4" hose thread is fitted with a one way valve you will want to remove it. To check for a one way valve look through the end of the female quick disconnect. If you can not see out the other end of the quick disconnect it contains a one way valve. I was able to use a standard screw driver to punch out the one way valve. The fourth photo shows the one way valve that was removed. The one way valve will impede the flow of nutrients and serves no purpose here so it is best to remove it.

Finally, screw the female quick disconnect onto the 3/4" PVC hose thread as shown in the last photo.



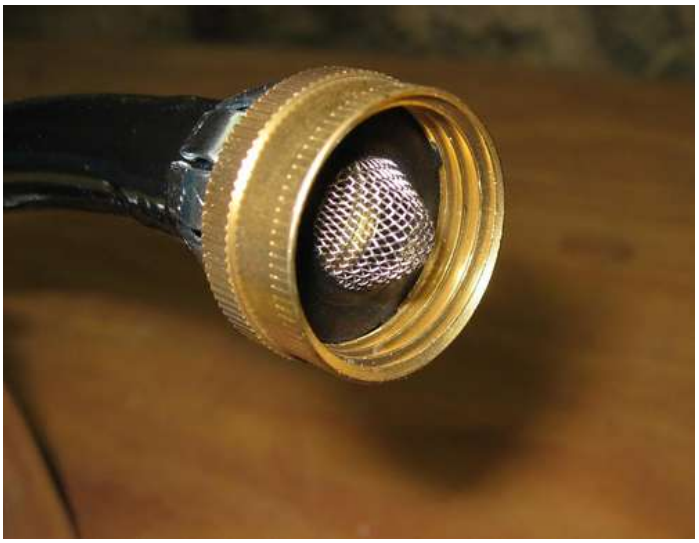


Image Notes
1. 3' of 1/2 flexible hose
2. 1/2" hose barb to female 3/4" hose thread
3. rubber washer with filter screen
4. male quick disconnect to male 3/4" hose thread
5. Female quick disconnect to female 3/4" hose thread

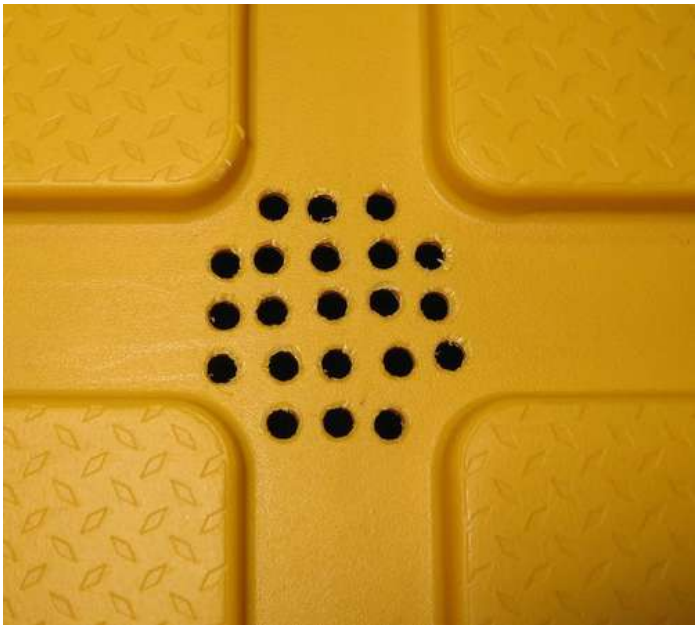
Step 11: Drill Drain Holes in Lid and Install Pump

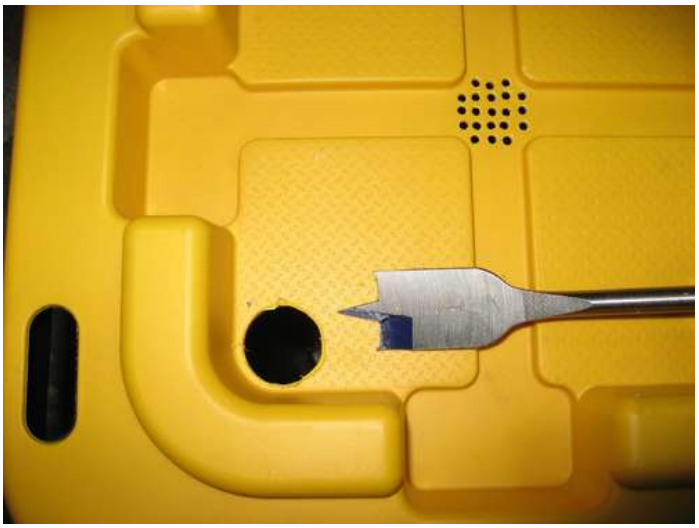
Use a 1/8" drill bit to drill drain holes in the lid as shown in the first and second photo. You will want to have drain holes in the center of the lid as sell as out near the 4 corners of the lid. Also note that the drill holes should be in the lowest channels of the lid where the nutrients would pool.

I used an awl to mark the pattern shown in the second photo, then drilled each mark using an 1/8" drill bit. I drilled many smaller holes rather than a couple large holes as this helps to keep any large material (such as the grow media) from falling into the box. Using a utility knife remove any plastic burrs left over from drilling.

Now choose the corner you would like the hose and pump cord to exit. Use a 1" hole saw or speed bore bit to cut a hole in the desired corner as shown in the third photo. Check to see if the plug of the pump fits through the hole. If it does not carefully widen the hole with a utility knife so the plug passes through. Using use some sand paper, a small round file round over the edges of the hole so it will not cut into the 1/2 hose or power cord.

Insert the water pump into the lowest recess of the plastic box in the corner the hole was drilled in (see fourth photo). Extract the pump power cord up through the hole in the lid leaving enough inside the box so that it does not pull on the pump. Now run the unconnected end of the 1/2" hose down through the hole and attach the hose to the water pump as shown in the fourth and fifth photos.





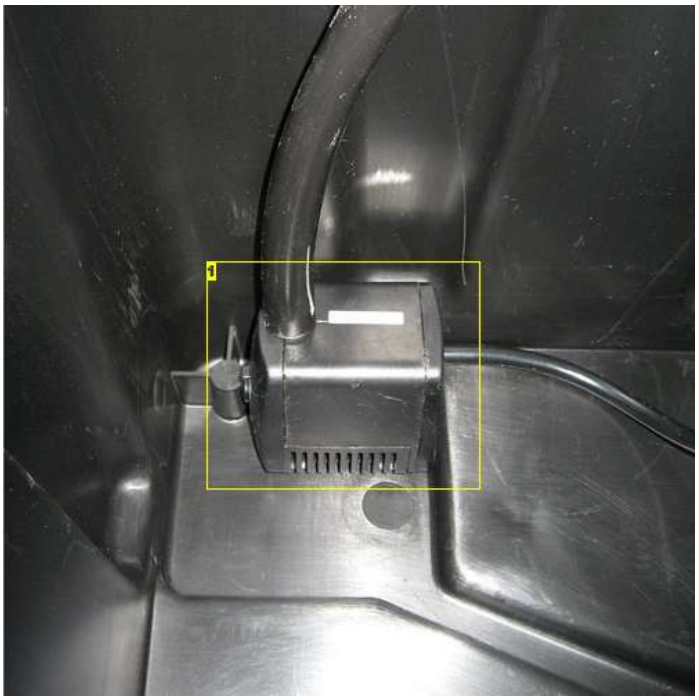


Image Notes
1. Active Aqua PU160 water pump

Step 12: Checking Operation

Put the PVC assembly on the plastic box lid and attach the hose end of the quick disconnect to the PVC end of the quick disconnect. Now place the 12 pots inside the two rectangles as shown in the first photo.

With the water pump unplugged, pour about 5-10 gallons of water into the large plastic box. Do this by pouring the water into the top of the pots slowly and allowing the water to drain into the plastic box through the holes drilled in the lid. This is a good test to make sure the lid drains well. Lift the lid slightly on the end with the hose and check to make sure the water pump is fully under water and firmly attached to the bottom of the plastic box. Close the lid again. Lightly insert the drip stakes or drip emitters to be used in the ends of the drip hoses. If you do not attach the drip stakes / drip emitters you may find that the pump cannot pump enough water to keep all the drip lines flowing. Plug in the water pump and look to see that water is flowing from each drip line. Allow the pump to run for half an hour and check that all lines are flowing and that no water is leaking out of any of the PVC or drip line connections. Unplug the water pump.

Step 13: Adding Grow Media and Drip Stakes

The pots I used have large holes in the bottom that would allow the clay grow media to fall out so I cut a small piece of screen and inserted it into the bottom of each pot (see first photo). Fill all the pots with grow media of your choice. I used clay balls for my grow media. Insert the drip stake near the middle of the pot, but towards the edge nearest where the drip line exits the PVC. Shorten the drip line to the appropriate length and attach to the drip stake as shown in the second photo.

The third photo shows an alternate watering method using inline and terminating drip emitters along with a hose stake. This way works very well also, and drip emitters are sometimes easier to find than drip stakes. Harbor Freight http://www.harborfreight.com sells a very inexpensive drip kit for about $6 which I used in the construction of the drip system in the third photo. You will need two of these kits as each kit only contains 10 inline and 10 terminating emitters.

UPDATE: The single stake emitter does not saturate the grow media as well as the two emitter system. The plants with the two emitters seem to do better than the ones with a single emitter. They both work, but I recommend using the two emitter system for best results.

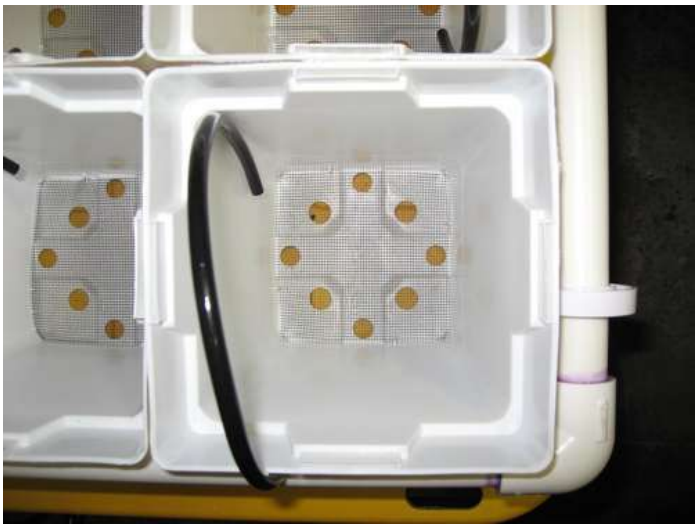


Image Notes
1. Inline drip emitter
2. Hose stake
3. Terminating drip emitter

Step 14: Operating the system.

Your hydroponic garden is ready for planting. Follow the planting instructions for the particular type of plant and media you are using. Note that the pots used in this system are good for small to medium sized plants. Most herbs and flowers as well as small plants like strawberries and beans should work well. Large plants such as tomatoes need more space as well as a larger pot size to really thrive, thus are not a good choice to grow in these small pots. Note that 4 pots could be removed to allow a larger (roughly 4X) sized pot to be added. This would allow you to grow larger sized plants such as tomatoes. The 4 drip tubes could all be used to feed the large pot providing an abundance of nutrients.

Staging Plants
I built two of these systems to allow plant staging. One system can contain Grow nutrients for vegetative plants like basil and spinach as well as be used to get flowering plants through their initial vegetative phase. The second system can contain Bloom nutrients for plants in their flowering and fruiting phase. Since all the pots are the same size, they can easily be swapped between the two systems.

The third photo shows a plant growing in a black plastic bag inside the white plastic pot. These grow bags can be purchased cheep at most hydroponic stores. This allows you to start tomatoes or other large plants using this system and when the plant gets large enough, the bag is removed from the pot and placed in a larger pot (such as the large bato buckets seen in the back of the second photo). The bag is then cut away and more grow media is added to fill the large bucket. This way if you have a single drip system for your large buckets (as I do) you can keep it flowing with Bloom nutrients only.

Adding Nutrient Solution to the System
I mix up the nutrients and water in a 5-gallon pail, and then I pump the nutrients onto the yellow lid and allow it to drain into the main reservoir. I use the same type of pump that is used in the system. This way I have a spare pump if one of the system pumps fail. If you do not want to buy a second pump you can either siphon or pour the nutrient solution onto the lid.
UPDATE: Currently I am mixing 5-gallon batches and adding more nutrient solution once the solution gets low. I check the amount of nutrient solution in the box but using a dip stick. Poke a thin stick down into the box through the hole the power cord / hose come out. You could add a level indicator to the system, but I would rather use a dip stick than drill holes in the body of the box personally. Follow the instructions for mixing and changing on whatever nutrients you decide to use.

Draining the Nutrient Solution from the System
Draining the nutrient solution is made simple by the quick disconnect. Unplug or shut off the pump. Then disconnect the hose from the PVC assembly. Place the hose in a bucket and turn on the pump. Pump out the nutrients until the pump starts to run dry. When the pump runs dry, the pump sound changes noticeably. At this point, turn off the pump, and reconnect the hose to the PVC assembly. You can tip the box toward the pump and get almost all the nutrients out if you want.

Operating the System
UPDATE: Get a mechanical timer that has 15-minute or 30-minute timing intervals. I currently have the timer set to water the plants for 30 minutes every hour that the light is on, and then once during the night for 30 minutes more. I was on a 15-minute per hour watering cycle, but I found larger plants did better on a 30-minute per hour watering cycle. It does not seem to matter to the small plants which cycle they are on.

Image Notes
1. Prototype hydroponic drip garden (with plants growing in it)
2. New hydroponic drip garden (constructed for this instructable)

Image Notes
1. Inline drip emitter
2. Hose stake
3. Terminating drip emitter

Step 15: Progress Updates...

The hydroponic system had not been in use for very long as of the original instructable publication (about 4 weeks). I will add photos and commentary to this section for future progress reports on how the system is working. the plants are grown under a 400W high pressure sodium light and I am using Botanicare Pure Blend Pro Grow and Bloom nutrients per manufacturers recommendations.

First Photo taken 3/21/09. Peas, summer squash, and tomatoes planted. All plants 1-2weeks old. Second drip garden not built yet.

Second Photo taken 3/28/09. Added 2 new jalapeno and 2 new tomato plants. Second Drip garden just completed, but not planted yet.

Third photo taken 4/5/09: Comparing to the 3/28/09 photo you can see that the plants have come a long way. About 2 weeks has elapsed between the two photos. The squash plants already have little squash and multiple buds. I transplanted the squash into the larger Bato buckets, which have replaced 4 of the small pots each. This shows how larger pots can be used with this system. The new tomato and pea plants have more than quadrupled in size. The only plants that have not progressed much were my jalapeno plants. I think I planted them a little early and the nutrients were a little strong which burnt them slightly.

4th-7th Photos taken 4/18/09: The 4th photo shows that the Peas have overtaken the meager trellis I built for them. I have now moved the two larger (6 week) tomato plants into the larger Bato buckets as seen in the 5th photo. The 6th photo shows that my jalapeno plants have recovered and are doing well. Finally I moved the summer squash Bato buckets onto the Bato drip system which is running only bloom nutrients. I think I may have to move the squash outside as I think they will get too big for my small grow area.

The 8th photo taken on 3/21/09 shows a tomato plant at 8 weeks grown exclusively in a Bato bucket. The tomato plant was about 2' tall and well into the flowering stage but did not have any fruit at this point. The 9th photo shows the same tomato plant at 12 weeks. The tomato plant is now over 4' tall and has dozens of smaller tomatoes (up to 1.5") and is still flowering.

The 10-12th photos taken on 5/5/09: The Peas in the 10th photo are flowering and about 2.5' high. Once the Peas are harvested I intend to grow green beans. I have read that green beans provide significantly more yield than peas. The 11th and photos shows the continued growth of tomato, pepper and squash plants. The squash plant is definitely moving outside once the weather gets warmer.

The 13th-15th photos taken on 5/17/09: Well it has been about 2 months since I started to keep track of the progress. The peas that were started at the beginning of this project are now 2.5' tall, still flowering and are now being harvested. The tomatos started at the beginning of this project are over 3' tall, flowering and bearing small tomatos. I am going to try to keep the tomatos pruned to under 4' tall. The jalapeno plants are really starting to take off and have started budding. With the tomato plants moving to the Bato system, space has opened up to plant basil, oregano, mint, and strawberries. The grow room is really turning into a jungle.

The 16th - 18th photos were taken on 6/14/09: Three months since I started keeping track of progress. I have been harvesting Tomatos, Banana Peppers, Bell Peppers, Lettuce and Snow Peas for the last month (see harvest section - step 16). The grow room is a regular jungle. The Peas are at peak production and appear to be slowing. I intend to replace the Peas with Green Beans. Photo 18 shows a couple of my Green Bean plants only 1 week after planting seeds. I choose a bush variety and hope to keep them under 3' tall. I have planted the beans in rockwool cubes as well as clay balls to see if which medium works best. I have a smaller bush tomato plant that I will try when some of my larger plants quit producing.

At this point I am going to stop tracking progress unless I get comments to do otherwise. It is a good amount of work keeping this page updated, and it is not clear that it is adding anything more to the project to keep it going. Clearly the drip garden has been successful.

Image Notes
1. Squash at about 2 week.
2. Peas at about 1-2 weeks.
3. Tomato at 2 week.
4. Tomato at 2 week.

Image Notes
1. Squash at 3 weeks.
2. Peas at about 2-3 weeks
3. Tomato at about 3 weeks.
4. Jalapeno at about 1 week
5. Tomato at about 1 week.

Image Notes
1. Squash at 4 weeks already with fruit. Transplanted into Bato buckets. I hope these plants don't get out of control.
2. New tomato plants at 2 weeks (back 2 pots) and 4 weeks (front 2 pots). Will eventually be moved to Bato buckets.
3. Peas at about 3-4 weeks, starting to climb like crazy.
4. Jalapenos at 2 weeks. Possibly stunted by nutrient burn.
5. More peas at about 3-4 weeks.
6. Sweet pepper plant . Unknown age but probably about 6+ weeks.

Image Notes
1. Peas at about 5-6 weeks. They have over-grown my meager trellis.

Image Notes
1. Tomato at about 6 weeks. Flowering started.
2. Tomatos at about 4 weeks.
3. Tomatos at about 2 weeks.

Image Notes
1. Jalapenos at about 4 weeks. Seem to have recovered from stunting

Image Notes
1. Squash at 6 weeks. Lots of fruit on bottom plant, none on top. Might have to move these outside or they might take over my small grow area.

Image Notes
1. 8 week old Tomato plant in Bato Bucket. About 2' tall.
2. Squash at 2 weeks. Note this photo taken at the same time as the first photo.

Image Notes
1. Tomato plant at 12 weeks now over 4' tall with lots of fruit! I need to look into a shorter variety as the plant is up to my light.

Image Notes
1. Peas at about 9 weeks. 2' tall and flowering.

Image Notes
1. Peppers at 6 weeks. Plants seems to have recovered and are doing well.
2. Tomatos at 4 weeks.
3. Tomato plant at 6 weeks, now planted in bato bucket.

Image Notes
1. Tomato at 6 weeks. Started in drip garden but now on bato bucket system.
2. Squash at 8 weeks. I plan to move this plant outside once it gets a little warmer.

Image Notes
1. Peas at about 11 weeks. 2.5' tall, still flowering. I have started to harvest the pea pods. Should make a good stir fry.

Image Notes
1. Ever bearing strawberries added to drip garden. Strawberries are planted in rockwool cubes.

Image Notes
1. Tomato started 10 weeks ago in drip garden, now on Bato bucket system. Plant is folwering and with small tomatos as seen here.
2. 8 week old tomato plant is flowering and should have small tomatos soon.
3. Pepper plants at 8 weeks are really starting to take off. Small buds are forming and should be flowering soon.
4. Basil, oregano, and mint now planted in drip garden.

Step 16: Harvest Updates

Per request I am adding a harvest update section.

The first five pictures were taken on 5/31/09. I have been harvesting produce for about 2+ weeks now. The first photo is of my Banana Peppers. You can see there are quite a few. The Banana Peppers are sweet (not hot) and very tastey on a salad. The second photo shows one of my bell peppers. There are many small bells (quarter size or smaller) and this one big one. The small ones have been growing extremely slowly, but seem to be taking off now. I have not harvested any bells yet. The Third photo shows some of the Peas that are growing. I get a handful of these every couple days. They taste great! Fourth photo is of my ripening tomatoes. They have been on the vine a very long time (17 weeks) and ripened really late. I think it might be because I have been supplying them with a lot of nutrient. I am going to try cutting off the nutrients on the next plant once the tomatoes are ready to ripen. I have harvested sever over the last couple weeks. The tomatoes are not as flavorful as I hoped. I'm trying a different variety next time. The fifth photo shows the days harvest which is going into my daily salad. It is quite satisfying to eat something you have grown.

The 6th photo was taken on 6/14/09 and shows the Jalapeno plants are bearing fruit. They are still small and I don't expect to be picking them for another week or two. I also added a picture of my Lettuce raft. I need to re-populate the raft after several of the sites went bad. I think I let the PH get too low. My friend has a lettuce raft that is producing all the salad he and his wife can eat. I hope to get mine back to that level soon.

Once I get this whole system tuned I figure I could be harvesting a couple salads a day. That would make the $1 I spend in electricity a day worth while.

Related Instructables

Aeroponic System by NaTeB1

Make a super-easy hydroponics system! by Rotten194

hydroponics grow kits - Grow it by hydroponicsgrowsl

Small NFT Hydroponics System by Weissensteinburg

Bubble lift hydroponics by Tool Using Animal

A Basic, Small, Cheap, Hydroponic Salad Raft by steveoondyou

Comments

44 comments **Add Comment**

daagom says: May 29, 2009. 3:10 PM **REPLY**

Wow that worked phenomenally well! I hope you add an image of your first big harvest. Good work and thanks for the instructable.

dirty_valentine says: May 29, 2009. 7:10 PM **REPLY**

I have started harvesting (as of a couple weeks ago. I get a hand full of peas each day; they taste great on a salad or in stirfry. I have many tomatoes but they are ripening very slowly (only about 5 picked so far). I have a bell pepper about ready and a bunch more on the way. picked about half dozen banana peppers with more on the way. All in all I'm pretty happy with the results considering the small space utilized, and only a 400W HPS light used. I have a feeling I will be slowly harvesting things, rather than have one big harvest. I will try to get a few pics up of the fruits of my labor. Thanks for the comment!

ralphkaz says: Feb 24, 2011. 2:29 PM **REPLY**

are you only using a single 400W HPS for all those different systems? if so, that's pretty good! do you have plans for either the float or bato bucket systems you are using as well?

dirty_valentine says: Feb 24, 2011. 7:50 PM **REPLY**

I never did an instructable on either of those systems. I designed those system based on "How to Hydroponics" by Keith Roberto. The book does a good job of documenting both those systems.

I was only using a single 400W HPS for all those plants, but I found that the plants at the croners were getting a little light deprived. I added a light mover and it helped out a lot.

lazer155 says: Nov 11, 2010. 9:43 AM **REPLY**

I transplanted some sprouts I was growing in dirt to my hydroponic system i built based off your instructions, however 2 days after transplanting them, they are starting to wilt. I thought it might be because I have my system outside and it gets down to about 45 degrees Fahrenheit at night. Could this be causing them to wilt? Or maybe they need more sunlight? I have them in a spot where they receive about 10 hours of sunlight a day.

dirty_valentine says: Nov 12, 2010. 6:24 AM **REPLY**

Wilting is usually a sign of lack of water. It is not uncommon for transplanted plants to experience wilting. By removing the dirt before planting in the clay balls (which you should do) you significantly disrupt the root structure. It will take time for the roots to regrow in this new medium such that they will begin taking up the nutrient solution. I would recommend you run the pump continuously until the plants come back to life (assuming they make it).

I have not had the best luck moving plants from soil to hydroponic medium. Removing the dirt is very traumatic to the plant but is necessary to keep the nutrient solution clean. For best chance of success I recommend starting plants in a hydroponic starter medium like rock wool or use Jiffy peat pellets. I have been using the peat pellets very successfully. They are cheep and you can find them at just about any gardening store. Good luck!

thebriguy says: Feb 24, 2011. 8:14 AM **REPLY**

When plants are moved the microscopic 'root hairs' break off and 'hurt' the plants roots - shocking them. They have to grow back to become healthy again.The only suggestions I have is to dig up the plant and wash away the dirt and be very careful and gentle. Nice instructable.

lazer155 says: Nov 14, 2010. 6:43 PM **REPLY**

Thanks for the advice. They seem to be doing better now, I added a few more sprouts and a day later they are also wilting. Hopefully they will come back like the others did. I'll try rock wool next time. About how often should I change my water reservoir if it's 25 gallons?

dirty_valentine says: Nov 14, 2010. 8:07 PM **REPLY**

I was changing it monthly when I started, but I was throwing out a lot of nutrients. Then I started waiting until the nutrients got low, then I would add an additional 5 gallons of nutrients. I found I was able to do this for several months (basically the life of the plant) without any bad results. I did need to adjust the ph a couple times, but the PPMs never got too high. I used a dip-stick to see how low the nutrients were and would add more nutrients when the level dropped to the height of the pump.

lazer155 says: Nov 18, 2010. 7:00 PM **REPLY**

The leaves of my lettuce, pepper, and tomato plants start drying at the tips of the leaves and the leaves gradually turn a silver, gray color. I can't find any information about what might be happing in the Hydroponics book Im using. My pea plants seem unaffected.

dirty_valentine says: Nov 19, 2010. 6:56 AM **REPLY**

I can't say for sure what the problem is. If they are seelings or young plants, make sure you use a weak nutrient solution. Too strong can burn the plants and ultimately stunt growth if it does not kill the plant. I have been making my nutrient mix to 1/2 the manufacturer recommendation. Too little nutrients will slow growth, but too much can seriously damage the plant. Also, the weaker solution allows me to just keep adding nutrients rather than changing them. You might also try running the pump continuously. I don't think there is any down side to that, other than the additional power. Just for the record, I have only been doing this a couple years and do not consider myself an expert. I'm kind of feeling my way through the process and doing what seems to work.

I have found that some plant types/varieties do better than others in a hydroponic setting. I have yet to find a green bean variety that did well for me. The green beans seemed to show a similar problem to what you described above, did not yield well, and I never got to the bottom of it. If you don't have good luck with one variety, try a different one the next time.

lazer155 says: Nov 21, 2010. 11:15 AM **REPLY**

They seem to have come back to life after I changed the nutrient reservoir out. Unfourtunately, I did lose one basil plant. I think they might have started dieing because the solution needed to be changed, it had been 3 weeks. I'll try cleaning it every 2 weeks instead. I have it system outside so I think it gets dirty faster than yours. I should probably get a nutrient meter and a ph meter.

lazer155 says: Nov 18, 2010. 6:52 PM **REPLY**

I'm having a new problem now with the tips of the plants' leaves drying up and eventually the whole leaf dries and dies. Is that a sign that the concentration of nutrients is too high?

dirty_valentine says: Nov 19, 2010. 6:58 AM **REPLY**

See comment on last post.

Fluxcap55 says: Nov 25, 2010. 11:47 AM **REPLY**

Great write up! I built mine adamantly less exact as yours. (No miter box)

Such an easy system to run, and very productive. The individual pots are great for rotating plants in and out of the system.

dirty_valentine says: Nov 25, 2010. 2:30 PM **REPLY**

Thanks, I'm glad you liked it!

lazer155 says: Jul 31, 2010. 8:53 PM **REPLY**

Do you have to monitor the ph levels? How do you know when to add more nutrients? Do you ever have to change the water entirely?

dirty_valentine says: Aug 1, 2010. 7:16 PM **REPLY**

I have become pretty lax about monitoring the PH and nutrient PPM. I'll do it about once a month and adjust PH if necessary. I started out changing the nutrients ever month, but that was expensive and time consuming. Now I just top off the nutrient holding tank when it gets low. The nutrient PPM never seems to get to out of wack using this method and I do not see a big difference in how the plants grow or produce. I did change the nutrients completely and flush the pots when I moved from the Grow nutrients to the Bloom nutrients. Most books recommend regular changing of the nutrients. I agree in theory that this is safer and should produce better results, but as I said it is more expensive and time consuming. Also, I think my yield is more limited by the size of my light source than the quantity/quality of the nutrients. If you are growing under sun light or a more powerful lamp, you might be better off changing the nutrients more often, but in my case I did not see a big difference.

lazer155 says: Jul 31, 2010. 8:24 PM **REPLY**

Are you still using a 2 inch pot for the big tomato plants? How do you know what size pot is best?

dirty_valentine says: Aug 1, 2010. 6:57 PM **REPLY**

No, I move the tomato plants into Bato Buckets. The Bato buckets are about 10" X 10" X 12". You can see the bato buckets behind the 6" pot setup in some of the photos above. I have been successful with peas, lettuce, and herbs in the 6" pots, but I use the Batos for my peppers and tomatoes. I bought a book called "Hydroponics for everyone" by S.K.Sutherland. It was helpful for learning about all aspects of growing hydroponically (pot size, nutrients, lights, etc.). I highly recommend it.

radioman_cut says: Jan 17, 2010. 9:46 PM **REPLY**

dude is that your underwear on the vise?

dirty_valentine says: Jan 18, 2010. 7:45 AM **REPLY**

I had to go back and look because it very well could have been. Alas it is only an old tank top T-shirt. If I do another instructable I might just have to include underwear for comedic effect. :-)

---

cuchulain92 says: Dec 22, 2009. 7:35 PM **REPLY**

Can potatoes be grown in this manner?

dirty_valentine says: Dec 23, 2009. 8:37 PM **REPLY**

I have not tried potatoes, but I have read that you can grow them in pearlite. The clay balls I used in this set-up would not work well. Also you would want to get a much larger container than the little 5" pots I used. You could try placing a big plastic tub filled with pearlite on top. You could set the PVC structure on top of the tub, or just replace the PVC with a couple drip lines off the pump. Good luck and let me know how it goes.

dirty_valentine says: Dec 23, 2009. 8:39 PM **REPLY**

Oh yea, don't forget to put drainage holes in the bottom of the plastic tub or your potatoes will be floating :-)

---

lasherza says: Oct 20, 2009. 2:51 AM **REPLY**

Mr Valentine,

This looks like an amazing setup! , a truly incredible instructable. I havent read it through but am very keen to give it a go with my chilli / pepper range soon. Off the top of my head i would imagine stronger lighting may improve the yields. Anyhow im going to examine this more closely..Nice one and thanks for the great instructable..

:-)

---

mslorraine101 says: Oct 10, 2009. 12:04 PM **REPLY**

When the plants flower, are you having to self pollinate or are you using some other method?

dirty_valentine says: Oct 10, 2009. 12:24 PM **REPLY**

To pollinate the Tomato plants, I just shake the stems with the flowers on them gently. I have been pollinating the pepper flowers by hand using a Q-Tip. I use a seperate Q-Tip for each variety of pepper (Bell, Jalapeno, and Banana). I think I could have gotten away with just shaking the pepper plants, but I wanted to make sure the flowers got pollinated. The peas and beans seemed to self pollinate with out any intervention from me.

---

mslorraine101 says: Oct 10, 2009. 10:48 PM **REPLY**

Thank you for everything.

---

mslorraine101 says: Oct 10, 2009. 12:15 PM **REPLY**

I love your system and I plan on implementing this IMMEDIATELY! My only concern is there a way to move the whole system on one water reservoir that uses only one pump rather than running off of multiple pumps. I like to share assets rather than having a new tub each system. I'd love this situation but is there a way to recycle the water by using a smaller container to catch the water, connect the containers and the dripping system in a series? I am looking on doing that using a stronger pump that is solar powered. I love this system

---

dirty_valentine says: Oct 10, 2009. 2:41 PM **REPLY**

Yes you can use a larger pump to water more plants from a single reservoir. You will need one or more drip trays (lid in my case) with a drain connecting back to the reservoir. You can buy plastic drain plugs from hydroponic shops that you put in the bottom of the drip tray. Then connect to a hose to the drain that goes back to the presidio. These drain plugs do not always seal well and can leak, but since you are outside you don't have to worry about that. My system with the lid over the presidio ensures no leaks, which is good for indoor gardening. You will need to place the drip trays higher than the level of nutrients in the presidio to allow drainage. Don't make it any higher than you have to because that means you need to pump the nutrients higher which requires a more power from the pump. Water is VERY heavy and most small fountain pumps can only pump the nutrients up 2-4 feet.

You can use the same method described in my system to connect your pump to a PVC pipe that runs near your plants. You can also use the same method of attaching drip hose to the PVC to provide nutrients to the plants. You will need to size your pump appropriately or you will get uneven watering of your plants. With the right sized pump there is no limit to the size of the system you can make - BUT - a larger system requires a larger reservoir. This is because when the system is pumping a certain amount of the nutrients will be in the PVC, making it's way through the pots, as well as in the drip tray. If the reservoir is too small the large pump can run the reservoir dry before the nutrients return to be recycled. This is not good for the pump.

I have looked into making an outside drip setup. I plan to start by setting up a system that runs on an outlet, then convert to solar if it is not too expensive. Setting up a solar powered system is not trivial or cheap. None of the 12V solar powered fountain pumps on the market are powerful enough to run even my small drip setup. The system I plan to set up would need about a 40W solar panel to service about 8-12 bato buckets. A good 40W solar panel is about $200+ and you still need a battery, charger, pump and disconnect circuit. Using a 12V pump would be easy, but they tend to be inefficient and may require a larger solar panel. The standard fountain pump I plan to use requires a 12V to 110V converter to run. A disconnect circuit should be used to shut down the pump if the battery gets too low. This can happen if the pump uses more power than the solar panel provides (think cloudy days). Also, note that you need to have some kind of clear roof over your system or rain will get funneled back into the reservoir and dilute your nutrients. Just setting up an outdoor hydroponic system is not trivial, and adding solar power makes it less so. I recommend you just try to get the system working on an outlet first, then switch to solar if you know what your are doing.

I personally like having several small systems. This lets me tailor the nutrients for the stage and type of plant growth (seedling to mature / vegetative or flowering). One large system does not allow this. Good luck and let me know how it goes.

---

mslorraine101 says: Oct 10, 2009. 8:36 PM **REPLY**
How is everything getting pollinated?

mslorraine101 says: Oct 10, 2009. 12:19 PM **REPLY**
Can the new system be achieved by running a separate pump for the drip system in a series and another for the water in a series?

dirty_valentine says: Oct 10, 2009. 2:51 PM **REPLY**
Not sure what you mean. This is a hydroponic system. The water is mixed with the nutrients, and the nutrient solution is then circulated from the reservoir, to the plants, then back to the reservoir over and over again. The pots are filled with an inert medium (clay balls in my case) not soil. If you are just looking to use a drip system to water plants in soil then this is probably not the system you need or want.

gwrober says: Aug 30, 2009. 4:40 PM **REPLY**
I like this system, obviously works well, and looks thought out well. We just moved, but as soon as things are settled I'm making one! Might have to make a smaller version, will post pics...

dirty_valentine says: Aug 31, 2009. 7:47 AM **REPLY**
Thanks for the comments. Would love to see the pics of the system you build. My system has been working extremely well and was much cheaper to build than the commercial systems.

gwrober says: Aug 31, 2009. 9:08 AM **REPLY**
I think I just got the green light from my boss (wife) so hopefully I can start on it soon!

albylovesscience says: Sep 15, 2009. 2:17 PM **REPLY**
lol boss/wife

dankyd1 says: Jul 23, 2009. 7:59 AM **REPLY**
Nice system!!! Your crop looks really healthy. I plan to make a variant of it.

dirty_valentine says: Jul 23, 2009. 3:48 PM **REPLY**
Thanks for the comment. Considering I'm only using a 400W HPS light I'm really happy with the results. I wish I had a greenhouse though. I think the plants could really use the extra natural light and so could my wallet. :-)

gooseflight says: Jun 12, 2009. 2:09 AM **REPLY**
Excellent! I particularly like the simple nutrient recycling. If I were to copy your system I would substitute LDPE with barbed connectors for the solvent welded PVC. LDPE is much easier to work with.

bwpatton1 says: Apr 8, 2009. 1:23 PM **REPLY**
Very simple but WONDERFULLY innovative

nmarta131 says: Apr 7, 2009. 4:53 PM **REPLY**
Wow that is WAY COOL!!! What a great way to go ORGANIC and to help solve a lot of environmental problem from using pesticides and herbicides. What an amazing system! I can't wait to make one myself!!!!

iinvnt says: Apr 6, 2009. 8:28 PM **REPLY**
Very good presentation from construction to operation. Good to see enough detail, such that this could be exactly duplicated. It is also good to see a sensible discussion of alternatives to help work through any problems that may arise. Well Done. -Joe