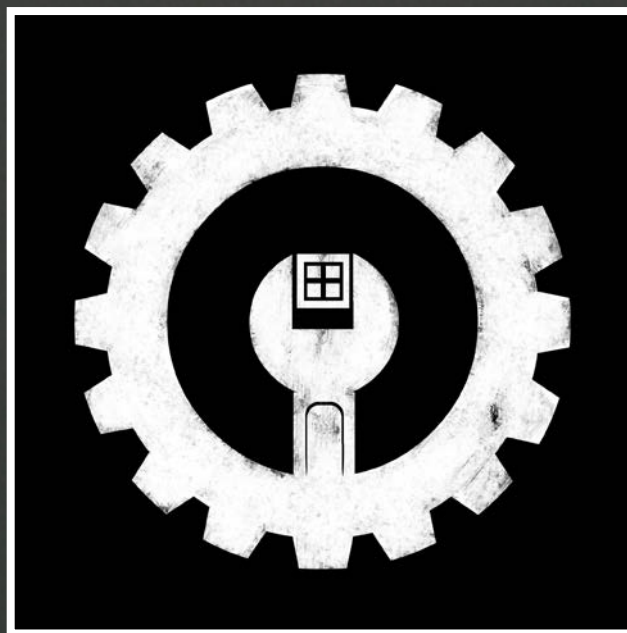


DIY Hydroponic Growing Systems



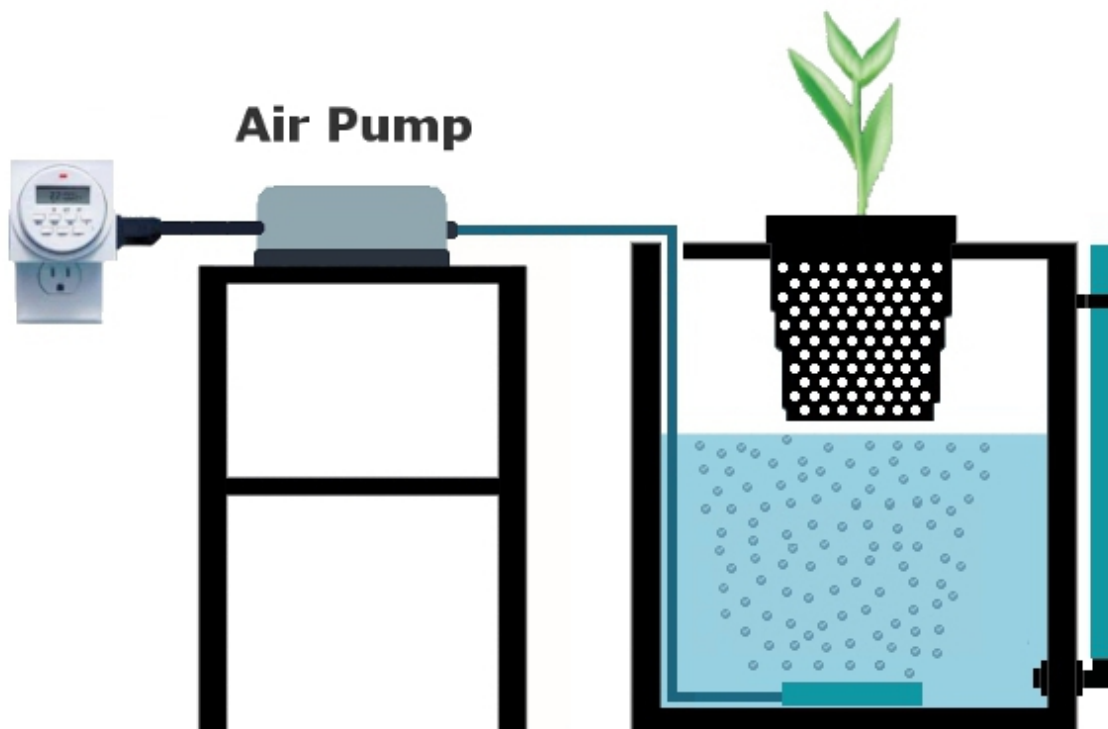
**Blueprints For Simple
Home Built Systems**

DIY Hydroponic Growing Systems

Bucket Bubbler System

This system may be the simplest hydroponic system that you will ever build. This system is much like Deep Water Culture (DWC) Systems, where the roots are suspended in nutrient filled, oxygenated water. This system is typically made for hydroponics, and uses fertilizer additives to give the plant what it needs.

This system is made for containing a single plant, and is made from a 5 gallon bucket with a lid, growing medium such as clay pellets or gravel, a netted cup bought, or home made from a plastic cup.



Material Required:

- **5 Gallon Bucket and Lid** - preferably black in color, though you can use another colored bucket and spray paint it black
- **Air Pump, Tubing, and Stone** – The air pump and stone are needed to oxygenate the water nutrient solution. An air pump designed for aquarium use works well

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- **Netted Cup** – You can either purchase netted cups, or make your own homemade ones out of plastic cups that are durable with tapered sides, the size of your raft will determine how many cups and plants you can have
- **Growing Medium** – You will need a small amount of growing medium, enough to fill the plastic cup
- **Water and Nutrient Mix**

Tools Needed:

- **Power drill** – cut hole in the lid
- **Hole Saw** – the size of netted pots you chose (make them small enough that the netted pots do not fall through)
- **Drill Bit** – to drill the ½” hole for the water level gauge, ¼” or larger the air tubing supply line hole
- **Tape Measure** – to measure tubing sizes
- **Safety Glasses**
- **Utility knife** – if you do not have a drill with a hole saw

System Assembly

- 1) You will drill or cutout a hole in the lid for the plastic cups to fit in, make sure that the plastic cups are durable and with tapered sides. You will want to make it large enough that the cup will fit mostly through the lid's hole, while the hole is not large enough for the cup to fall completely through. Allowing it to hold up and stay in place
- 2) Then you will drill a ¼” hole in the lid, to allow for the ¼” air tube to fit
- 3) You will then run the airline through the hole, down to the bottom of the bucket, and attach the air stone to it. Leaving enough airline in the bucket so that the air stone will lay flat on the bottom
- 4) Next, you will fill the bucket to just slightly above the bottom of the netted cup, or higher if needed for sprouting a seed, with nutrient solution that is mixed according to the nutrient's directions and then place the lid on the 5 gallon bucket.

Note: After the roots have grown to a few inches below the netted cup, you will

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need to lower the level of the nutrient solution to be within an inch below the bottom of the net cup

- 5) You will then hook up the other end of the air tubing to an air pump and see if the nutrient water in the bucket is bubbling
- 6) Once you have checked for bubbles, you will place your plant in the netted cup, while its roots dangle from the bottom of the netted cup and fill around it with the growing medium such as clay pellets or gravel. Once the plant has been planted in the netted cup with the growing medium, you will place the cup into the 5 gallon bucket's lid and Tada! You are done setting your system up.

System Modifications

This Bucket Bubbler System can be easily modified, where you can add a Water Level Gauge by simply by cutting out a ½" hole on the side of the bucket, near the bottom, insert a ½" rubber grommet, connected to a ½" elbow, and attaching a short piece of see-through vinyl tubing directed to the top of the bucket, and attached in place, as to not allow it to fall over and drain out.

These types of systems may also be linked together with a central reservoir using the same ½" rubber grommets, a ½" barbed fittings, and ½" vinyl tubing.

Also, this type of system can be recreated using most any other type of container that can hold water, and is dark in color to shelter the roots from sunlight. Another popular container type that people have used for a bubbler system is Rubbermaid® Totes and containers. With these larger containers, you can build systems that can hold many more plants that can be used for small plants, or clones.

Care and Feeding Instructions

You will need to watch and monitor the water level in this system; if the water gets too low you plant will suffer. When your plants have used up the nutrient rich water, you can add more water to bring the water level back up, and recheck the pH and adjust it if necessary. Be sure to not add fertilizer, as it can cause a nutrient buildup and harm your plants.

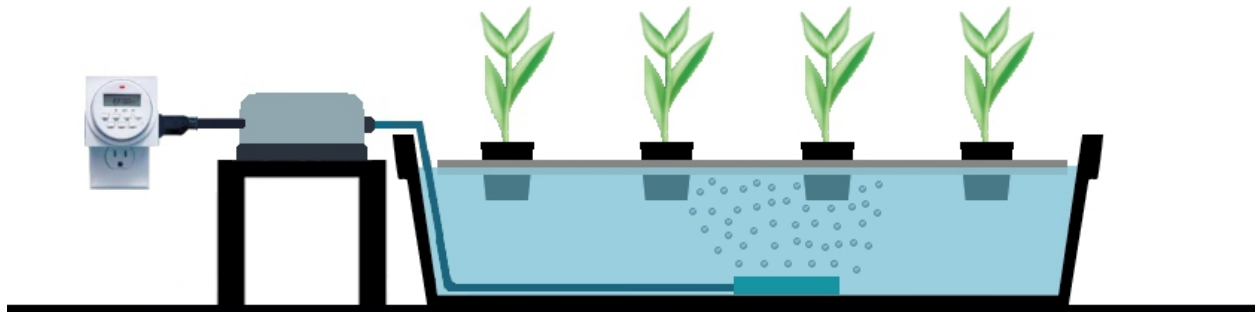
When you plants have used up half of the nutrient solution for a second time, you will need to change out the nutrient solution by draining it from the reservoir and then mix up a fresh batch of solution for the system. You can however use the leftover nutrient solution on other soil plants or outdoor gardens.

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Deep Water Culture System

Deep Water Culture (DWC) – Is a method where the plant roots are suspended directly into a water nutrient solution that is oxygenated. You can convert a typical household aquarium or water tight container into a simple deep water culture or raft system. A raft system is where the plants are on a raft, typically made from Styrofoam that makes the plants float with its roots suspended in water to grow plants.

The nutrient-rich water is constantly being aerated to keep the nutrient water fresh, and the plant's roots healthy and oxygenated to live. These systems can either be completely contained within themselves, or they can be tied to or connected to other systems reservoir, such as an Ebb and Flow hydroponics system, or an aquaponics system with fish, to provide the nutrients that the plants need to live.



Materials Required:

- **Aquarium or Water Tight Container** - Any water tight container that has near vertical sides, that is dark in color, as light breaks down the nutrient solution, encourages algae growth, and is harmful to plant roots. If you use an aquarium you will need to construct a light shield to keep light out of the reservoir. If you wish to view the roots, then make the light shield removable.
- **Floating Raft** – The most common material is Styrofoam that is between 1-½” to 2” thick and cut the Styrofoam board to fit loosely inside of the reservoir

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- **Netted or Plastic Cups** – You can either purchase netted cups, or make your own homemade ones out of plastic cups that are durable with tapered sides, the size of your raft will determine how many cups and plants you can have
- **Growing Medium** – You will need a small amount of growing medium, enough to fill the plastic cup, most commonly expanded clay, or a perlite/vermiculite mixture
- **Air Pump and Air Stone** – The air pump and stone are needed to oxygenate the water nutrient solution. An air pump designed for aquarium use works well
- **Water and Nutrient Mix**

Tools Needed:

- **Power drill** – cut holes in Styrofoam
- **Hole Saw** – the size of netted pots you chose (make them small enough that the netted pots do not fall through)
- **Tape Measure** – to measure Styrofoam cut size
- **Safety Glasses**
- **Utility knife** – if you do not have a drill with a hole saw

System Assembly

- 1) After gathering all of the materials, you will cut the Styrofoam to size to fit the reservoir, with a little extra room to move
- 2) Next, you will cut out the holes on the raft for the netted cups to fit in place, cutting the holes large enough to fit in the hole, but not fall through
- 3) If you are building your own netted cups, you will cut out several holes of about 1/8" to 1/4" diameter in the bottom of your cups. If you have growing medium falling through the holes, you can remake them or use window screen to cover the holes before adding the growing medium
- 4) Fill the reservoir with the nutrient water, mixed as instruction on the fertilizer recommend. Check the pH and adjust it accordingly. Keep in mind that the pH will vary from one plant to another plant type
- 5) You will then attach 1/4" air tubing to the air stone, and place the air stone in the reservoir. Attach the free end of the air tubing and plug in to the air pump and

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plug that into an outlet. Never submerge the air pump into the water, as it uses electricity and can result in shock or death

System Modifications

This raft system can be scaled up or down to any size that you would like, though the only limiting factors to this system is that the number and size of plants are limited to how much weight the Styrofoam board can hold without sinking.

This system can be adjusted to have a standing drain pipe that drains into an ebb and flow system reservoir, as well as pumps from the reservoir, providing fresh water to the plants. This system can also be used in aquaponics systems, tied to a fish tank and grow beds.

Care and Feeding Instructions

When your plants have used up around half of the nutrient rich water, you can add more water to bring the water level back up, and recheck the pH and adjust it if necessary. Be sure to not add fertilizer, as it can cause a nutrient buildup and harm your plants, if you are using hydroponics fertilizer additives.

When you plants have used up half of the nutrient solution for a second time, you will need to change out the nutrient solution by draining it from the reservoir and then mix up a fresh batch of solution for the system. You can however use the leftover nutrient solution on other soil plants or outdoor gardens.

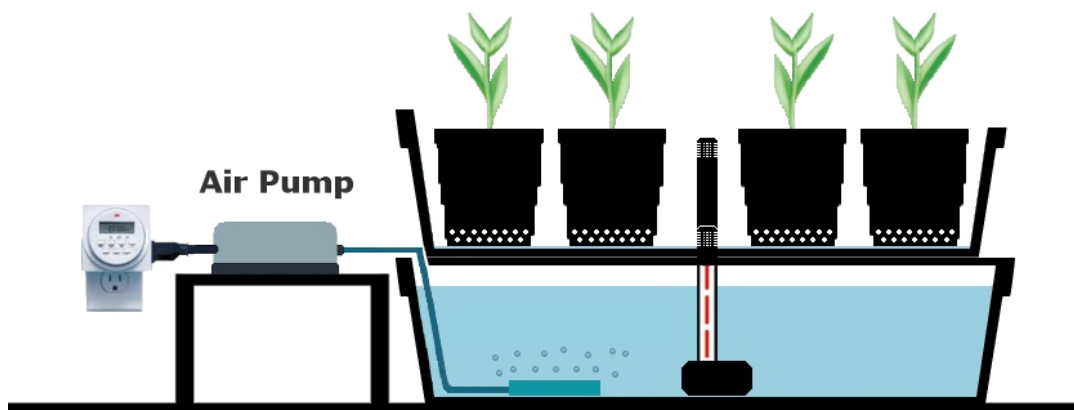
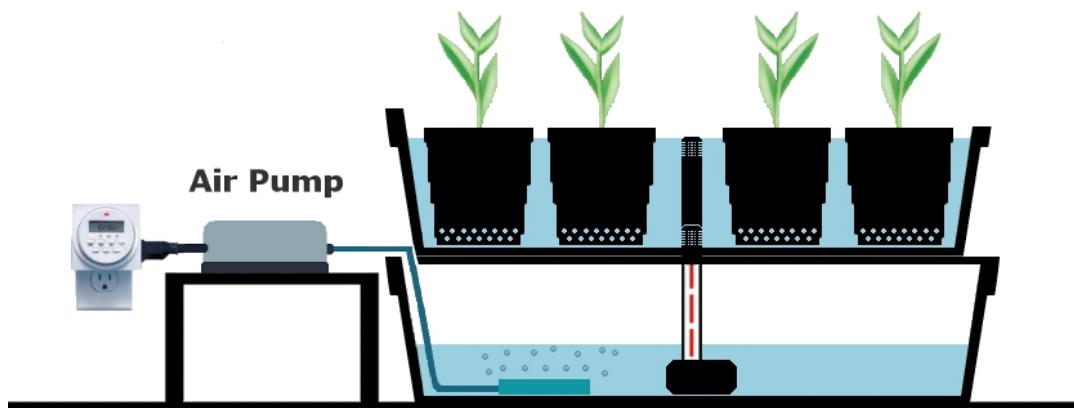
If you are using this system and it is tied to an aquaponics system, there will not need to be any water changes, or fertilizers added to the system. The fish feed, chelated iron, liquid sea weed, and fish waste that are added to the system provide the nutrients needed.

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Ebb and Flow System

The Ebb and Flow, also known as flood and drain, is one of the most popular system used in hydroponics as well as aquaponics. These systems are very easy to understand, build and maintain. They are flexible in scale and design, and can house netted pots of any size. Plants that are individually planted in pots are placed on a drain table or growing bed, which can hold a set amount of water, usually a few inches. Periodically, a timer will kick on, pumping nutrient solution from the reservoir, into the grow bed, flooding the bed, and up to a certain point.

The plants are watered from the bottom of the grow bed through the drain holes in the pots. After watering the plants for a while, the water pump turns off and the water then drains back down to the reservoir. This flood and drain cycle repeats 2-4 times a day or more if set. This is a great, inexpensive, dependable system where you can grow four 6-8 inch pots, or many smaller plants in small pots. You can find most of the materials at your nearest home supply store, or hydroponics supplier, while other parts you may need to order online.



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Supplies Needed

- **Rubbermaid Black Storage Tote w/ Lid**- 16-20 gallon
- **Rubbermaid Snap-Toppers Clear Tote** – 28-34 quart
- **Electric Timer** - 15 minute increments
- **Air Pump, Air Tubing, and Air Stone**
- **Netted Pots or Cheap Flower Pots 8” or Smaller**
- **Growing Medium** – Expanded Clay or other growing medium
- **Black Irrigation Tubing** - ½ “ I.D. (inner diameter), 18” long
- **Water Pump** - small submersible, 120 gph
- **Fill and Drain** - Fitting Set w/ One Extension
- **Water and Nutrient Mix**

Tools Needed:

- **Power drill** – cut holes
- **Hole Saw** – 1-1/4”
- **Drill Bit** – for air tubing and water pump electrical lines
- **Teflon Tape** – for sealing the bulkhead fitting threads
- **Tape Measure** – to measure tubing size
- **Safety Glasses**
- **Utility knife** – if you do not have a drill with a hole saw

System Assembly

- 1) Start by cutting out two 1-1/4” holes in the center of the clear Snap topper tray and then smooth the rough edges lightly sanding them with sandpaper.
Note: Your pots need to fit around these 2 holes, so before drilling the holes, place the pots in the container and make sure the drain holes will fit in between them.
- 2) After cutting the drain holes on the clear tray, you will place it on top of the black tote lid, and center it. Mark the exact center of each hole through the tray and onto the black lid with a marker. Then cut the two 1-1/4” holes into the black lid where you marked them. The idea is to line the holes for the drain fittings to fit properly.
- 3) Next, you will cut 2 additional 1-1/4” holes into either side of the top of the black lid, where one is for the pump plug and air tubing to pass through, while the other is to check the fluid level of the reservoir and to add nutrient solution after the system is assembled and running.

DIY Hydroponic Growing Systems

- 4) Next, screw the two drain fittings into the center holes in the clear container only. Remember that the rubber gasket goes on the underside of the bin. Hand-tighten them securely, but do not use tools or you can strip them out. Place only one extension on the overflow tube (the taller tube)
- 5) Now, place the ½" irrigation tubing over the water pump outlet fitting. Depending on the type of tubing or hose you use, you may have to secure the tubing onto the pump outlet with a zip tie. You want the tubing to fit securely on the pump.
- 6) Place the clear container with drain fittings in place, in line with the holes in the black lid. They should line up nicely and snap down onto the black lid.
- 7) Cut the ½" black tubing to a length that allows your water pump to sit on the bottom of the black tote (aka reservoir) when the lid is on. Then push the tubing over the port of the shorter drain tube (the ½" inflow tube) from the bottom side of the black lid. You can use a zip tie if needed to get a snug fit.
- 8) Place the air stone in the bottom of the reservoir and run the air tubing and the pump through the side access hole that you drilled into the side of the lid. Then place the lid/tray assembly on top of the tote, and snap it into place.
- 9) Make a dipstick out of a piece of wood, or dowel rod. As you pour in 2 gallons of water to the reservoir at a time, place the dipstick in and mark it with a permanent level at each point until the reservoir is full. This will help you gauge the level of the nutrient water later without removing the tray, lid, and plants.
- 10) Fill the reservoir with 10 gallons of water. Add your choice of nutrient concentrate. Once you have added the nutrient at the recommended dosage per gallon, you will then adjust the pH of the solution by first testing the nutrient water. Then plug in the air pump and water pump and test the system to see if everything is working properly and there are no leaks. Be sure that the system is on a level surface, as the top tray can flood if not level.
- 11) Now, you will take the plant pots, and if they need drain holes, you will drill several ¼" or 3/8" holes around the sides towards the bottom of the pots, as well as a few on the bottom of the pots, this will provide good fill and drain of the nutrient solution. Then fill the pots with the growing medium that you choose, though we recommend using LECA (Hydroton or clay balls).
- 12) Now plant your plants into the pots and pack the medium carefully around the plant, being sure not to damage the plant or its roots. It is not recommended to start seeds directly in ebb and flow pots, as the nutrient mixture or moisture will not reach the top to keep the seeds moist. It is best to start them first in grow

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cubes or pellets and plant them into the pots. When you first plant plants into the system, be sure to top water the plants for the first several days to help them adjust to the system.

System Modifications

This Ebb and Flow system can be scaled up or down to any size that you would like, though the only limiting factors to this system are the number and size of plants that can fit in a tray, the size of the flooding table area, and the size of the reservoir. This system can be tied to other systems such as a DWC Raft system, or be used in aquaponics systems, that are tied to a fish tank and grow beds.

Care and Feeding Instructions

When your plants have used up around half of the nutrient rich water, you can add more water to bring the water level back up, and recheck the pH and adjust it if necessary. Be sure to no add fertilizer, as it can cause a nutrient buildup and harm your plants.

When you plants have used up half of the nutrient solution for a second time, you will need to change out the nutrient solution by draining it from the reservoir and then mix up a fresh batch of solution for the system. You can however use the leftover nutrient solution on other soil plants or outdoor gardens.

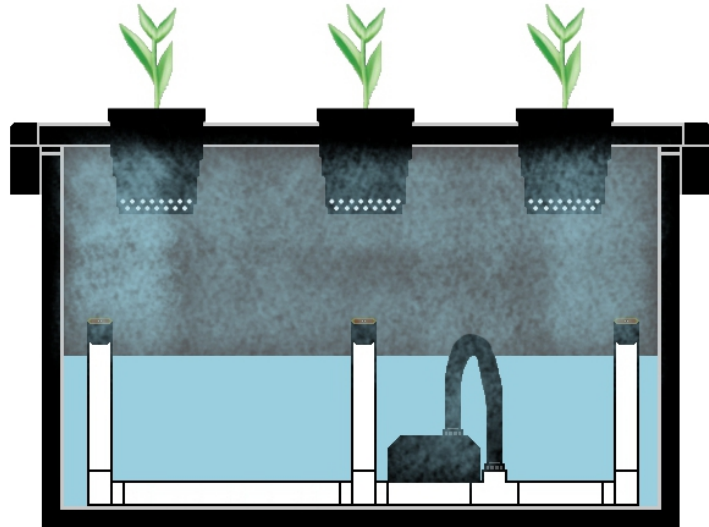
If you are using this system and it is tied to an aquaponics system, there will not need to be any water changes, or fertilizers added to the system. The fish feed, chelated iron, liquid sea weed, and fish waste that are added to the system provide the nutrients needed.

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Aeroponics System

Aeroponics is a simple, easy, worry-free way to grow and clone vegetables, herbs and plants. Aeroponic gardening is growing plants without soil, where the roots are suspended in air and sprayed with a water nutrient solution.

Unlike hydroponics, which uses a growing medium as well as water that is delivered by drip systems, flood and drain, and NFT systems to sustain plant growth, aeroponics is conducted without a growing medium and the water is sprayed on to the roots.

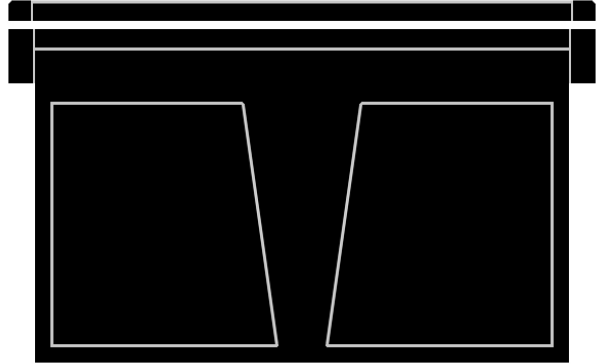


Supplies Needed

- **30 Gallon Tote with Lid** – aeroponic system container/reservoir
- **Air Pump, Air Tubing, and Air Stone** – aerate nutrient water mix
- **3/4" slip to 1/2" threaded PVC connectors - 6**
- **3/4" slip "T" connector with 1/2" threaded top**
- **1/2" threaded bulkhead fitting with gasket**
- **1/2" barb to male threaded connector**
- **3/4" PVC – 77"**
- **3/4" slip "T" PVC connector - 2**
- **180 degree 1/2" brass head threaded sprinkler heads - 6**
- **12" black flexi-tubing**
- **1/2" hose clamp**
- **1/2" flexi-tubing shut off valve**
- **200 GPH Fountain Pump**
- **Rubber or Foam Weather Strips** – flat or rectangle in shape, long enough to line the rim of the tote, about 10'
- **3/4" slip "cross" or "4-way" PVC connector**
- **3/4" slip "elbow" PVC connector - 6**
- **Water and Nutrient Mix**

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- **Hydroponic Netted Pots with Foam Lids** – 6 or more, depending on what size of plants you are growing, a good size is around 3.75" netted pots with lids.

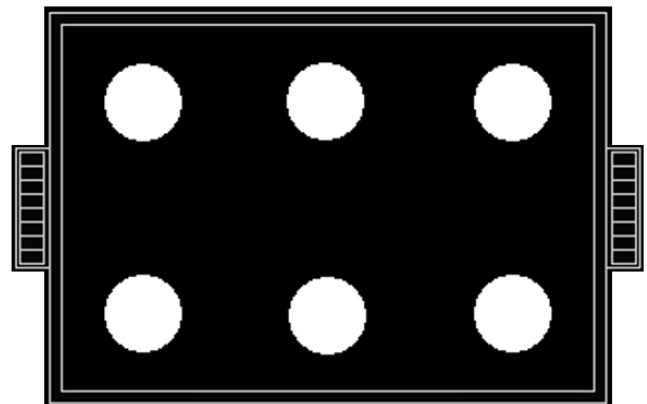


Tools Needed

- **Caulking Gun** – seal where needed
- **Saw** - to cut PVC
- **PVC Primer & Glue** – to connect fittings together, if you want to be able to clean them out, do not glue them together
- **Hole Saw** – size of the netted pots & bulkhead fitting
- **Drill** - for hole saw
- **Teflon Tape** – for sealing the bulkhead fitting threads
- **Tape Measure** – to measure PVC sizes
- **Safety Glasses**
- **Utility knife** – if you do not have a drill with a hole saw

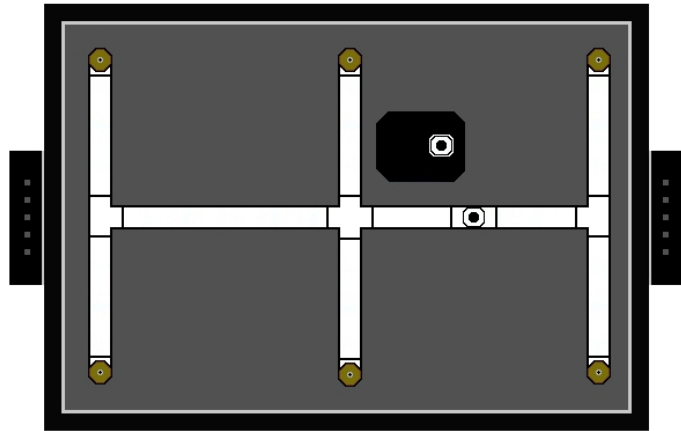
System Assembly

- First, you will want to decide what size netted pots you are going to use. The pots should be spaced a few inches apart, giving room for future plant growth. Six 3.75" netted pots for medium size plants, fewer larger pots for larger plants, and more, smaller pots for smaller plants
- Next, carefully cut your holes for your netted pots. You can use a utility knife instead of the drill and hole saw. The net pots should fit tightly in to the holes, but not fall through
- You will then cut the PVC to sizes as follows: 6 pieces that are 4 ½" long, 6 pieces that are 6" long, 1 piece that is 8" long, and 2 pieces that are 3" long
- If you are using PVC glue and primer, you can use it, otherwise connect the 4 ½" PVC pieces to the PVC elbow connector and the 6" PVC pieces, the 6" piece will act like a riser



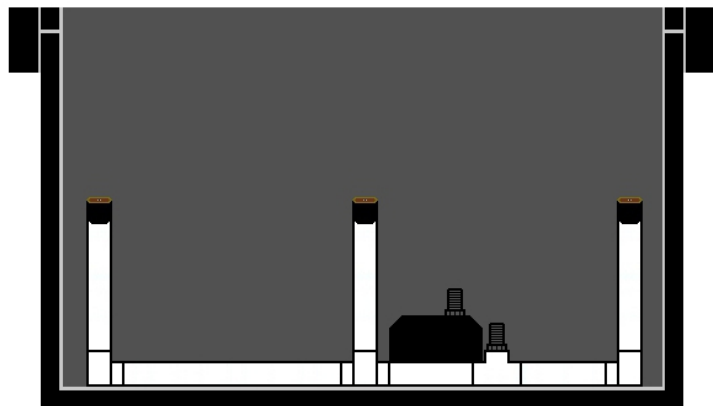
DIY Hydroponic Growing Systems

- Next, attach the 3/4" slip to 1/2" threaded PVC connector and screw in the sprinkler heads
- Now, connect the two 3/4" "T" PVC connectors and one 3/4" "cross" PVC
- Connect the two 3" PVC pieces to the 3/4" "T" with the threaded 1/2" top. As well as connecting the 8" piece to the risers. Then screw in the 1/2" barb to 1/2" threaded connector.
- Now place the PVC sprinkler system you built inside the tote. Connect the fountain pump to the PVC unit using the 1/2" flexi-tubing, being sure there are no kinks in the tubing
- Install the weather stripping on the lid, where the top rim of the tote and the lid meet. This will help to eliminate any water leaks from the system
- Install the bulkhead fitting at the desired location along the bottom of the unit. Attach the shut off valve with flexi-tubing as a drain valve to drain out your system
- Insert the net pots with foam lids, fill with water to just below the sprinkler heads and turn the system on



System Modifications

This Aeroponics system can be scaled up or down to any size that you would like, though the only limiting factors to this system are the number and size of plants that can fit in a containers lid, the size of the water pump, the size of the tubing and spray emitters. Be sure that when you are choosing the pump size and

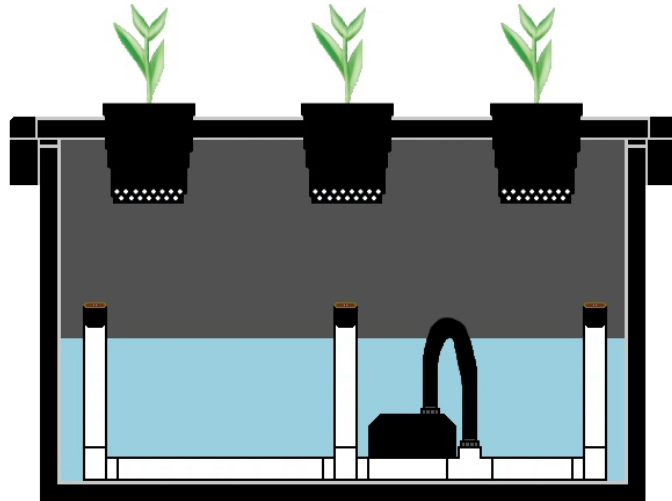


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tubing size, that the tubing is not too small, and the pump too large, as having too much water pressure can harm plant roots.

Care and Feeding Instructions

When your plants have used up around half of the nutrient rich water, you can add more water to bring the water level back up, and recheck the pH and adjust it if necessary. Be sure to not add fertilizer, as it can cause a nutrient buildup and harm your plants.



When your plants have used up half of the nutrient solution for a second time, you will need to change out the nutrient solution by draining it from the reservoir and then mix up a fresh batch of solution for the system. You can however use the leftover nutrient solution on other soil plants or outdoor gardens.

If you are using this system and it is tied to an aquaponics system, there will not need to be any water changes, or fertilizers added to the system. The fish feed, chelated iron, liquid sea weed, and fish waste that are added to the system provide the nutrients needed.

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Nutrient Film Technique (NFT) System

Nutrient Film Technique (NFT) systems are some of the most productive systems available, and they are often the chosen method of commercial growing. These systems are used in both hydroponics and aquaponics.



NFT system involves using a tube or channel to hold plants and directs nutrient enriched water that constantly flows to a plant's roots. A wide range of vegetables and ornamental crops may be grown in an NFT system. Depending on the width of the channel, the NFT system is great for plants from lettuce to as diverse as tomatoes. This system is a simple example of near infinite possibilities in size, layout, and materials.

The plant roots are grown in a light shielded, sealed, shallow channel, where the nutrient solution is continuously circulated, flowing over the roots up to 24 hours every day. The name of this growing method was named in order to tell that the depth of the liquid flowing past the roots should be very shallow in order to ensure that a sufficient amount of oxygen is supplied.

In these kinds of systems where there is no growing media to hold any moisture, the roots of plants can dry out very quickly. Which is why the watering cycles are frequent, and it will be up to you to determine what that takes. Some NFT growers leave their systems on to run continuously. To be on the safe side, you could begin with watering every half hour and slowly ease off until you find the perfect point.

Because hydroponics requires a nutrient reservoir for water to be stored, drawn from, and returned to, the water runs simultaneously, which needs a large enough reservoir to have water left over for the water pump not to burn up. Most NFT systems build them with a minimum of two channels that allows for the water to go full circle and return back to the reservoir.

Along with the water flow from the water pump, these systems use gravity to assist the flow of water. Each end of the PVC is higher than the end that comes next in the circle. The end of the tube where the water enters from is the highest, and the end that it leaves from is the lowest. To achieve this, you can build supports out of lumber, PVC, or

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hang from a structure, that supports them and keeps them high enough to be above the reservoir, so gravity will return the water back to it.

Supplies Needed

- 10' length of 4" PVC Pipe, Cut in three
- NFT Stand – 2x6's or 2x4 frame
- Screws – 1" – 1½" Wood Screws
- 4" Rubber End Caps with Hose Clamps
- Small Submersible Pump
- Air Pump, Stones, and Tubing
- 3" Netted Cups or 16oz Plastic Cups
- Irrigation Tubing – ½" to ¾" Diameter
- Rubber Grommets to fit the Tubing
- NFT Fittings – 4 Straight Connectors
- Reservoir – 5 Gallon Bucket, Container with Lid, or Aquaponic Fish Tank
- Growing Medium – Expanded Clay
- Hydroponics Nutrient, or Aquaponic System Fish



Tools Needed

- Saw
- Drill
- Utility Knife
- Standard Screwdriver
- 3" Hole Saw
- Screws

System Assembly

- Once you have figured out what type of container that you are going to use for a reservoir, you can start designing your stands, which will be taller than the reservoir. We used the stand heights of 16", 17", 18", and 19", since our reservoir has a height of 14".
- After cutting the lengths out of the 2x6's, you cut a triangle (with a center height of 2.5") out of each one to hold the PVC in place. Next, attached them together with the 2x4's, placing the 2x4's horizontally, midway up the 2x6's.

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- You will need a spade bit to drill a hole for your tubing to connect into each of the end caps. Drill the holes at the height that you want your water level to be at. You want to make the holes high enough on the end caps to be sure the water level is high enough that the bottom of your cups will be submerged. However, what I did to make it adjustable is to put the hole on the outer edge of the fitting. Then to adjust the water height, you merely rotate the rubber fitting and it will adjust the water height.



- The pump you purchase should come with a removable attachment for the tubing, which you can attach it to a piece of tubing long enough to reach from the upper tube to the bottom of the reservoir or fish tank.
- I then pushed the tube that is connected to the Straight NFT fitting through the hole in the top NFT line end cap. Then push another piece of tubing with an NFT fitting long enough to reach from the top tube to the lower tube. Then do the same from the lower tube to the reservoir or fish tank. Then attach two end caps via tubing long enough to fit on both pieces of PVC.
- When I tested the system like this, it ran surprisingly well, with a just a few small leaks. You can use plumbing cement to seal around the outside of all the tubes. Though plumbing cement isn't the most safe substance (toxicity wise), and even though it's probably OK, by just sealing the outside, it at least makes me feel better about. Luckily this stuff cures in two hours, so you can do another test run pretty quickly. Though I personally prefer not to use the cement and just tighten the fittings well into place.
- A lot of people recommend cleaning everything with a heavily diluted bleach



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solution to help ward off algae. I did this before I had drilled any holes. It was easy to fill the pipes and then shake them with the end caps on.

- Depending on the type and number of plants, the spacing of your holes will be different. With this system it will have six plants, so my spacing worked out to be 8-9 inches between each hole. You will want to use a hole saw to drill out the holes for the netted cups, with a 3" diameter saw. If you use a Dremel to cut out the plastic, make sure to wear a mask and be in a well-ventilated area. After cutting the pipes, rinse the dust off of the pipes.
- On the reservoir lid, you will want to drill out three holes in the lid, one for the water supply line, one for the drain line, and one for the power cord and the air tubing.
- By leaving the lid on the container, it helps to reduce the amount of evaporation that occurs, as well as any splashes from draining, or debris from falling in to the reservoir.
- If you are using purchased netted pots, they will be ready to use. If you are making your own homemade netted pots out of plastic cups, you will need to drill plenty of holes in the bottom and edges of each one of the plastic cups, to allow the plant's roots to be able to come into contact with the nutrient rich water.
- Direct the lower tubing or side to the direction that faces the sun or artificial lighting, so the whole system can get equal amounts of sunlight. Double check to be sure that the stands are all in the right orientation so the water being pumped to the channels starts at the highest point, then slowly progresses downward, then dropping to the next channel, progressing downward, and then finally dropping back down into the reservoir.
- When you purchase or find a growing medium, you will want to be sure that the medium is clean and sterilized before you use it in your system. If you are using a newly purchased medium, all you will need to do is to rinse off the medium



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before using it, allowing for any dust or debris to wash away. If you are using rock or gravel you found, you will want to rinse it as well as wash it in a Hydrogen Peroxide mixture to sterilize it before use, and then rinse it again.

- **NOTE:** If you are finding a medium to use, be sure that it is inert, pH neutral, and does not contain any harmful chemicals or debris.
- If you are transplanting from soil, be sure to wash out as much dirt as possible before placing the plant in the system, as the dirt can clog up the water pump and cause issues. Be sure to clean them gently and not kill the plant. Once the roots are clean, you will then hold them in place with one hand, while you use your other hand to fill the cup with the growing medium, gently around the roots.

When you are placing the plants in the system, be sure to keep in mind what kind of plant they are, and place taller plants in the back, so they do not block out all of the sunlight.

System Modifications

This NFT system can be scaled up or down to any size that you would like, though the only limiting factors to this system are the number and size of plants that can fit in the channel tubing, the size of the water pump, the size of the tubing and the reservoir size. Be sure that when you are choosing the pump size and tubing size, that the tubing is not too small, but allows for an adequate amount of water flow draining out so the channels do not flood over the top.



These systems can be made into many different formations such as having each and every piece of tubing at the same height, where all of them are fed and drained at equal levels. Other layouts include placing them to work as a vertical garden, giving you more growing area. Other NFT systems can be built using plastic gutters or fencing posts in place of the PVC piping.

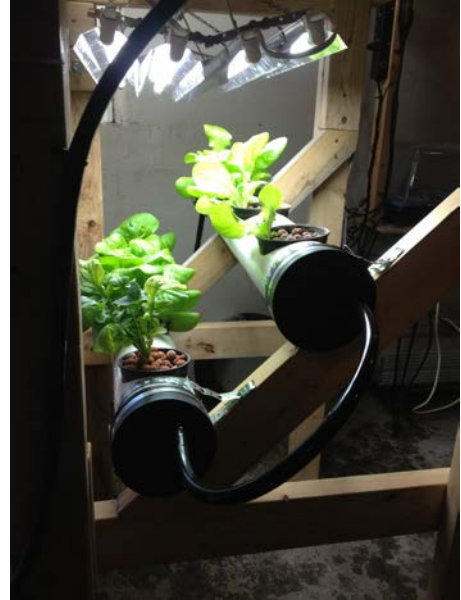
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Care and Feeding Instructions

When your plants have used up around half of the nutrient rich water, you can add more water to bring the water level back up, and recheck the pH and adjust it if necessary. Be sure to not add fertilizer, as it can cause a nutrient buildup and harm your plants.

When your plants have used up half of the nutrient solution for a second time, you will need to change out the nutrient solution by draining it from the reservoir and then mix up a fresh batch of solution for the system. You can however use the leftover nutrient solution on other soil plants or outdoor gardens.

If you are using this system and it is tied to an aquaponics system, there will not need to be any water changes, or fertilizers added to the system. The fish feed, chelated iron, liquid sea weed, and fish waste that are added to the system provide the nutrients needed.

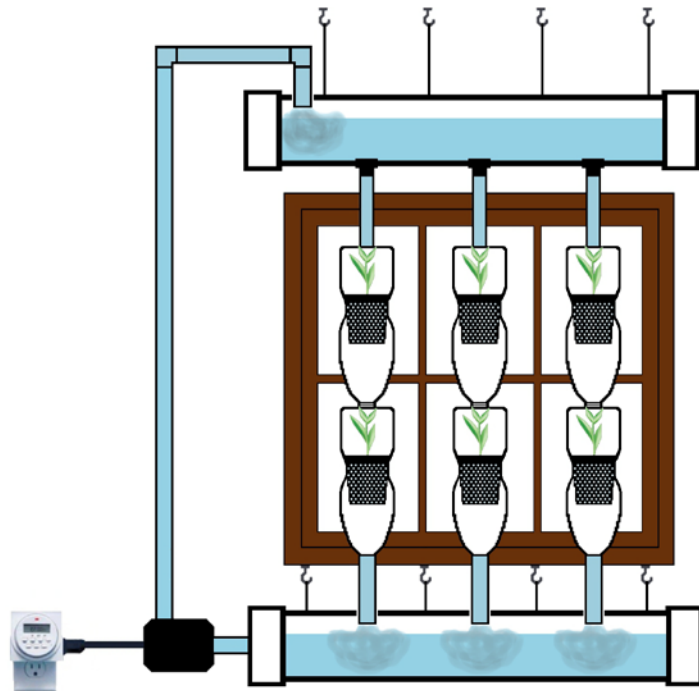


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Window Garden

The window garden is a gardening system that is made to fit in windows in small apartments and limited spaces using natural sunlight to grow. The water is pumped from a bottom reservoir or body of water; these are typically made from either: PVC Piping that is enclosed, aquariums, Rubbermaid totes, or any other waterproof container.

A water pump then pumps the nutrient rich water up to the top of the window and fills up the upper reservoir that acts like a manifold and directs the water to the series of plastic bottles that have been cut to hold netted pots that growing medium and plants can be placed in. These large plastic bottles act as a channeling system to direct the water to the plants down the line and back to the reservoir via a drainage tube.



The bottom and top reservoir as well as the vertical hanging window garden can be held in place by either hooks in the ceiling or window, or by a frame stand that holds the whole system upright and in place.

Supplies Needed

- Water Pump - Inline, or Non-Submersible (Size Depends On Head Height and System Size)
- Flexible Irrigation Tubing - 1/2" to 3/4" Depending On Size
- Irrigation Connector – (1) – Straight Slip Fit NPT
- Netted Pots – If Wanted - 2-3" Diameter, Number Depends on Size
- Plastic Bottles - Number Depends on Size
- Hooks and Rope, or Custom Built Stand
- Electric Timer

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- Top Reservoir - 3" PVC Piping
- Rubber PVC End Caps (4)
- Bottom Reservoir - PVC, Plastic Container, Bucket
- Growing Medium
- Roll of Strong Fishing Line or String (10-20 Pound)



Tools Needed

- Utility Knife
- Scissors
- Drill
- Drill Bits - Same Size Of The Tubing You Use

System Assembly

- You will begin construction of your system by first figuring out what window you will be using. Once you have picked the window, you will take measurements of the window and the area surrounding the window. Doing this will help you on your way to designing and building your own system.
- Next, you will decide on what type of reservoir that you plan on using, will it be hanging, sitting on the floor, on a stand, etc. When you have decided on that, you will then determine the high from which the pump will be sitting and how high the water will be pumping up to the top reservoir. Doing this will give you the head height which will determine the size of pump you need for your system.
- At this point you know the pump size and, where the reservoir will be placed, the design and layout of your system. Taking the width of the window into consideration, you will cut some 3" PVC to the same size as the window, and if you are using the bottom reservoir that is made from PVC, then cut 2 pieces.



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- Once these have been cut, you will then cut holes in the top of the bottom reservoir, these will be the drain holes where the plastic bottles will drain into. After this is done, you will then drill or cut out a small hole in one end cap for the bottom reservoir, this will be the hole for the Straight Slip Fit NFT connector that supplies the water to the water pump.
- Next, you will take your plastic containers, and cut a round hole in the bottom of the plastic container, that is about 1 inch in diameter, this will be the hole for the drain line from plant container to another.
- On those same plastic bottles, you will then cut a hole through one side of the bottle, keeping in mind that the bottom is top and top is bottom with this system. Make an Oval Cut three quarters of the way to the top. The size will vary on the size of plastic bottle that you have chosen to use.
- Next, you will make 2 holes in the top of the plastic bottles sides, where the fishing line or string can go through one end and out the other. This string is ran through each bottle. Tying each individual bottle up to the top reservoir to hold the bottles in place.
- Whether you are hanging the system from hooks, or have a custom built stand, you will then hang or setup your top and bottom reservoirs up. Next, you will connect the additional plumbing lines from the reservoirs to the pump. Once you have these connected, you will then take the plastic bottles and tie them up to the top reservoir for them to stand upright.
- Once your system has been tested, you will then plant plants into the netted pots that you have and fill them up with growing medium that you choose to use, the lighter the better, such as lava rock, expanded clay, or similar growing media.



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- Then you will place these netted pots into the holes that you cut in the plastic bottles. If the bottles want to tip at an angle, you will want to either cut the holes a bit more and move the netted pot to fit better, or tie another string to the bottle, around the neck of it and tied it down vertically to hold it properly in place.
- Now you will fill up the reservoir with water and nutrient additive and test the system to make sure it is running properly and has no leaks. If the system is working properly, your system is ready to fully run.

System Modifications

This Window Gardening system can be scaled up or down to any size that you would like, as well as using other types of materials to make the pots or any other components. However, the limiting factors to this system are the number and size of plants that can fit in the plastic bottles, the size of the water pump, the size of the tubing and the reservoir size.

Be sure that when you are choosing the pump size and tubing size, that the tubing is not too small, but allows for an adequate amount of water flow draining out so the channels do not flood over the top. This system is a simple system made partially from used plastic bottles, hanging clay pots, hanging plastic containers, or bamboo.

Care and Maintenance

When your plants have used up around half of the nutrient rich water, you can add more water to bring the water level back up, and recheck the pH and adjust it if necessary. Be sure to no add fertilizer, as it can cause a nutrient buildup and harm your plants.

When you plants have used up half of the nutrient solution for a second time, you will need to change out the nutrient solution by draining it from the reservoir and then mix up a fresh batch of solution for the system. You can however use the leftover nutrient solution on other soil plants or outdoor gardens.

If you are using this system and it is tied to an aquaponics system, there will not need to be any water changes, or fertilizers added to the system. The fish feed, chelated iron, liquid sea weed, and fish waste that are added to the system provide the nutrients needed.

