DIY HOME HYDROPONICS FOR BEGINNERS

The Essential Guide To Turn Your Backyard Into A Farm

SALLY R. BALL

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Introduction

Congratulations on getting *DIY Home Hydroponics for Beginners: The Essential Guide to Turn Your Backyard into a Farm.* There are many books on the market about this topic, so thank you for choosing this one. The following chapters in this book will cover the difference between soil gardening and hydroponics, different types of hydroponic systems, choosing the right system and building it, managing lighting, providing the right nutrients, water maintenance, best plants to grow, and common issues and troubleshooting.

The world is changing quickly, and vast expanses of grass that waste water are a thing of the past. We need to take care of our planet and ourselves. What better way to do so than to plant food in our yards instead of grass. This way we can control the chemicals and pesticides put on our foods and know that we are nourishing our bodies with the healthiest food possible. Plus, it is a great way to save money. Organic produce can be expensive. When you invest a little money in building a sustainable hydroponic system, it will definitely pay off in the long run.

Read on to learn about how to make this dream a reality. With the right know how and a little elbow grease you can have an amazing garden that will be the envy of the neighborhood. Sleep well knowing that you are doing what you can to help the planet and put the best food possible in your body. It just might be easier than you think.

Chapter 1: The Difference Between Soil Gardening and Hydroponics

Everyone has heard of gardening. Put plants in the ground, water them, and cross your fingers that they grow. Of course, this method has worked for thousands of years. Over time, these methods have been tweaked and made better. We know that plants need several things to grow: water, air, nutrients, light, and a place to anchor their roots. All of these things can be accomplished in the soil, but soil farming takes up a ton of space. Open lands are shrinking and the population that needs to be fed is growing. What if there was a better way?

The emerging answer is hydroponics. The basis of a hydroponic system is simple, it is growing plants without soil, in a water-based environment. Nutrients are fed to the plants through the water. With a hydroponic system, food can be grown inside a house, in a warehouse, outside, in places with poor soil, and even in outer space. Using hydroponics has many up sides. It is more sustainable and produces a higher yield. The water and nutrients are used through a recirculating system, which means less is wasted. When you grow plants without soil, that means there are no weeds, diseases, or pests such as gophers or moles. When these issues go away, so can pesticides, which means healthier, higher quality produce emerges.

It is certainly a great idea to create a hydroponic garden indoors. However, many people do not have the space and it can get a little more expensive with all of the lights, air conditioners, dehumidifiers, and other trinkets needed to get things going inside. Therefore, it could definitely be in your best interest to create a great summer hydroponic garden in your backyard.

This will be much more cost effective and not take up a ton of room in your home.

Perhaps you could even take the learning experience of building an outdoor hydroponic garden and make a small one inside during the winter months. It could be very nice to have something like a tower garden going during the winter months to continually provide your family with fresh produce year-round.

This all sounds great right? Healthy food that uses less of the planet's resources and contains fewer pesticides. There are six main methods of hydroponic gardening. There are easier systems such as wicking or deepwater culture, and more advanced ones such as aeroponics, drip, ebb and flow, and nutrient film techniques. Consider starting with an easier system, and once that one is mastered, move on to a more advanced system. It is likely that one successful gardening venture will surely lead to others. Let's take a closer look at each type of these systems, so that it will hopefully become clear which one is the best to start with.

Chapter 2: Wicking

What is Wicking?

Let’s start simple. As a full disclaimer, a wicking bed does still use soil, so it is not a pure hydroponic system, but this system waters the plants from the bottom up. In a normal garden, it is difficult to keep the soil happy. When watering from the top, much is lost to evaporation, and it is also hard to ensure the water reaches the correct depth; one foot for most vegetables, two feet for larger plants. This depth is not only hard to achieve with typical watering, but nearly impossible to maintain. When using a wicking bed, the moisture level can be kept constant. When there are even moisture levels, there are happy plants.

How to Build a Wicking Bed Garden

1. Choose a container to use for your garden. This should be sturdy, non-toxic, able to hold water, and 18 to 24 inches deep. This allows room for the roots to grow. Purchase something new or look around your property for something to use. Also, check out social media or check with friends to see if anyone is giving a suitable container away.

2. Choose a good location to place the container. It is wise to position the container in an optimal place before filling it with water, soil, and plants. It will be awfully heavy once filled up! The container should be in a location that gets at least 6 hours of sunlight per day. If the sun is intense where you live, it may be a good idea to also provide some afternoon shade. It is also a good idea to put the container near a water source and in a convenient place for running out to grab some produce for dinner.

3. Level the container so that the water is distributed evenly.

4. Place a pipe or drip hose in the container. This should run from the top of the container all the way to the bottom. This is how you will add water to the reservoir. A strong drip hose, a piece of perforated PVC pipe, or a weeping tile would work well. Just find something that will not be pinched or crushed when the soil is added. Make sure the pipe or hose sticks out of the top of the container so that water can be easily added.

5. Place five to ten inches of clean gravel in the bottom of the container. This should cover the pipe. It is a good idea to use clean, sterile, medium-

sized gravel so no preexisting pathogens are present in your bed, and so there is space for water to flow between the rocks.

6. Use landscape fabric to line the bed and keep the water reservoir separate from the soil. Cut the fabric so its edges run up the sides of the container, so that the soil does not fall into the water reservoir. Do not use plastic; the water needs to be able to wick up into the soil.

7. Place a half-inch—and only a half-inch—of sand over the fabric to help keep the soil level.

8. Drill a few holes in your container at the top of the water reservoir, where the soul will meet the water. This will allow rain to flow through and not waterlog the soil.

9. Fill your bed with soil. It is a good idea to use new, high-quality, organic potting soil instead of native soil.

10. Add the plants. Transplants work best in this system because seeds need the moisture to be in the top inch of soil to germinate.

11. Fill the bottom reservoir with water. Go all the way to the soil line, until water starts to flow out of the drilled holes.

12. Add some water from the top. This allows the wicking action to start. It is wise to water from the top for just a few weeks, until the roots grow enough to reach the moist soil.

13. Place mulch over the top of the soil. This will reduce evaporation and keep the top of the soil from getting too hot or cool.

Maintaining a Wicking Bed

Once the plants are growing, they need to be fed, so add some organic fertilizer. Either place the nutrients right in the soil or opt for water soluble ones that can be placed right in the water reservoir. Either could be a great choice. Talk to a representative at your local garden store for advice if needed, or just follow package directions.

The water in your wicking bed also needs to be kept fresh. Add water once a week. Fill the reservoir until water begins to drip out of the drilled holes. Flush out all of the water a few times a year to help keep salt, algae, or bacteria from growing. If mosquitos are a problem in your area, place a bit of screen over the opening of your fill pipe. This will keep them out of the reservoir.

Also, refresh the soil in your garden each year. While the bed is empty over the winter, add some compost or fresh soil. Do this a bit before spring planting to keep the soil healthy and vibrant. Worms can be a welcomed addition to the garden as well. Worms really enjoy moist soil. Consider adding a worm “tower” feeding tube to give the worms some delicious and nutritious food, which will in turn create some beneficial “fertilizer” for your plants.

A wicking bed can be a great place to start in the hydroponic world. It combines what many people are used to, growing plants in soil, with using more sustainable water practices. This will also create a more optimal growing environment and increase the health and yield of plants. The

instructions for creating a wicking bed are also very simple and can easily be done by anyone.

It is also inexpensive and can be a fun project to tackle with the whole family.

Chapter 3: Deep Water Culture

What Is Deep Water Culture?

Deep water culture may sound a bit out there, but it is actually one of the easiest hydroponic methods to start with. It is also one of the most popular. As a very basic explanation, in a deep water culture system, the roots of the plants sit suspended in water that is oxygenated and full of nutrients. This is a very popular system, because it requires very little maintenance once it is all set up, the plants grow extremely fast when compared to growing in soil, there are very few parts needed, and assembly really is not that complicated. As with anything, proper maintenance is an absolute must, but once started this can be a great option.

How to Build a Deep Water Culture System

There are a few different ways to build a deep water culture system. Since this book is for beginners, let's talk about a traditional deep water culture system, as this is the easiest to build. Most of the parts needed for this system can be found online, in a home improvement store, or in a pet store. Here is a list of needed items:

5 Gallon Bucket, old aquarium, or another large container
Air Pump
Air Stone
Airline Tubing
Net Pots
Growing Media (natural clay pebbles)
Hydroponic Nutrients
pH Control Kit

Once all of these items are collected, begin building your deep water culture system.

1. Connect the air pump to the tubing.

2. Connect the tubing to the air stone.

3. Place the air stone in the bucket.

4. Fill the bucket up with water.

5. Properly pH the water. Most plants prefer the pH to be between 5.5 and 6.5. Just make sure that you monitor this number and know that it changes when the plants are in different stages. When plants are growing, the pH needs to be higher; when the plants are flowering, it needs to be on the lower end.

6. Add nutrients to the water. There are many options out there for nutrients. Talk to your local garden center to find the best fit for you. A very simple solution to start out with is the General Hydroponics Flora Series. Follow the instructions to mix up varying amounts to use based on the plant's stage of growth.

7. Start your seeds. During this process, it is important to keep light out of the container. It might be a good idea to put duct tape over the sides and bottom of the container to make sure algae does not grow, especially if your container is not dark to begin with. Place the seed in the plant growth media, and put in the net pot. The roots should begin to develop in about seven to fourteen days.

8. Watch in amazement as the roots hit the water and there is an explosion of growth. As long as proper oxygen and nutrients are provided, the plant can live quite well submerged in the water its whole life.

The traditional method is a really good place to start. Once this method is old news and an upgrade is desired, look into creating a recirculating deep water culture system. This system allows multiple buckets to be used to

grow the same plant. There is one main reservoir that feeds the nutrient solution across all of the buckets.

Maintaining a Deep Water Culture System

There are a few common issues that often come up with this type of system. It does take a while to get the hang of pH, water level, and nutrient concentration. Plus, in a small system, these numbers can fluctuate greatly. Another problem that can arise is a power outage. The roots can “drown” if a pump fails and the solution becomes low in oxygen. The water temperature can be another issue. It is optimal to keep the water temperature below 68 degrees and above 60. The oxygen level begins to drop in higher temperatures, and the plant may get confused into thinking it is moving into fall or winter if the water temperature gets too low.

With proper monitoring and maintenance, most issues can be overcome easily and quickly. The nutrient solution will need to be changed out occasionally. The solution should be changed out completely at least every three weeks. A little more research will likely need to be done to see how often this should be done. It depends on the type of plants that are being grown, the size of the reservoir, and the stage of growth the plants are in.

A couple other things to watch for are the number of roots submerged in the water and, root related plant diseases. Make sure that no part of the stem or vegetation is ever submerged. It is best to have an inch or inch-and-a-half of the roots exposed above the water line. Bubbles form the air stone should rise to the top and pop to keep the roots above the water line moist. Also, keep an eye on the plants to make sure they look healthy. Diseases like Pythium can strike and devastate a plant.

It may take a little trial and error to find the best location for this system. Of course, natural light is always best for plant growth. However, maintaining the water temperature could be a bit difficult in direct sunlight, especially if the sun is intense in the yard. This system could be put on wheels and moved around, or placed in a window, sunroom, or greenhouse. If things only work out indoors, artificial lighting options may need to be used.

Chapter 4: Aeroponics

What is Aeroponics?

A more advanced technique, aeroponics is a way to grow plants while they are suspended in midair. That’s right, the plants are not in soil or water; they are simply exposed to a nutrient-rich, misty environment. This system can work indoors, in greenhouses, and outdoors as well. There are two types of hydroponic systems: high pressure and low pressure. The high pressure systems are much more advanced and use less resources for growing. These have even been used by NASA to grow vegetables. However, these systems are a bit much for the average back yard gardener. Low pressure systems are the most commonly used and built by those looking for a project for their own home.

How to Build an Aeroponic System

Aeroponic systems can certainly be purchased all complete and ready to go, but it is much more cost effective to build your own. There are several different designs out there for an aeroponic system. There are methods for a five gallon bucket, a tower garden, and many more. Only one method will be discussed in this book, but feel free to check out others online if this construction method does not meet your needs. This method will be made inside a 30 gallon plastic tote with a lid.

Materials Needed:

- (1) 30 gallon tote with lid, preferable dark in color
- Hydroponic net pots with rubber foam lids (size and quantity will depend on the size of the plants you plan to grow)
- Electrical timer that can be used in 30 minute increments
- (77”) of ¾” PVC pipe
- (6) ¾” slip “elbow” PVC connector
- (1) ¾” slip “cross” PVC connector
- (2) ¾” slip “t” PVC connector
- (6) ¾” slip to ½” threaded PVC connectors
- (1) ¾” slip “T” connector that has a ½ inch threaded top
- (1) Tube of silicon caulking
- (1) ½” flexi-tubing shut off valve
- (1) ½” threaded bulkhead fitting with gasket
- (1) ½” hose clamp
- (1) 12” black flexi-tubing

- (1) ½” barb to male threaded connector
- (6) 180 degree ½” plastic head threaded sprinkler heads
- (1) Fountain pump (200 gallon per hour)

1. Grab your 30 gallon plastic tote with lid. The darker the color, the better to prevent algae growth. Also collect your net pots. The size of these will vary depending on what you plan to grow. Pots that are 3.75” would work well for something like tomatoes. Choose something smaller for smaller crops or larger for larger ones. Cut holes in the lid of the tote that will allow your net pots to sit snugly inside the holes. A craft knife works well for cutting these holes.

2. Grab 3’4” of ¾” PVC pipe. Make sure to get PVC, not CPVC, as this is known to leach harmful chemicals. Cut this pipe into the following increments:

- (6) 4.5” lengths
- (6) 6” lengths
- 8” length
- 3” lengths

3. Collect 6 PVC elbow connectors and use PVC glue and primer to connect the 4.5” lengths to the 6” lengths. These will make an “L” shape. The 4.5” length will be flat on the ground and the 6” lengths will be rising into the air.

4. Attach the ¾” slip to ½” threaded PVC connector to the top of each 6” pipe of each “L” shape. Now, screw in sprinkler heads.

5. Collect two ¾” “T” shaped PVC connectors and one ¾” “cross” PVC connector. Use the PVC primer and glue to connect your “L” shaped pipes together. Connect two sets of them with the “T” shaped connector and one set of them with the “cross” connector.

6. Visualize your PVC pipe creation sitting in the bottom of your tote and spraying water up at the roots of your plants. Use the 8” section of cut PVC pipe to connect one of the “T” connectors to one side of the “cross” connector. On the other side of the “cross connector, add one of the 3” sections of pipe, then add the “T” connector that has a ½ inch threaded top the opening pointing straight up, then add another 3” section of pipe, and lastly, glue this into the other “T” connector you already added.

7. Add a ½” barb to ½” threaded connector into the part of the “T” connector that has been left sticking up.

8. Place the sprinkler unit into the tote. Use ½ inch flexi-tubing to connect the fountain pump to the sprinkler unit. Take care to ensure there are not any kinks in the tubing.

9. Put the lid back on top and use caulking to seal the lid on top. Make sure there are not any gaps in the caulking and let it dry completely before using the system.

10. Attach the bulkhead fitting wherever you would like it on the bottom of the tote, and put on the shut off valve with flexi-tubing as a drain valve.

11. Put in the net pots with plants. Fill with water to just below the sprinkler heads and place on a timed cycle of 25 minutes on and 25 minutes off. Add nutrients to help your plants thrive.

Try using a humidity dome to help young cuttings thrive.

Maintaining an Aeroponic System

Like all systems, problems can arise in an aeroponic system. It is very important to make sure the pump is working properly. If the pump fails, the plants will end up in a very sad state. The nutrients used can also clog up the sprinkler heads. Keep an eye on these, and clean them with isopropyl alcohol occasionally to keep them clear. If the situation gets too far out of hand before noticed, the sprinkler heads may need to be replaced.

There are several methods out there to combat bacterial and fungal growth in these systems. This is a very common problem just because of the damp, warm environment. Use a small amount of hydrogen peroxide to kill off the bacteria. Just be aware that using this will also kill off any beneficial bacteria or fungi in the supplements used.

The roots of plants prefer to grow in total darkness. Therefore, it is important to not let in any sunlight to the box. All leaks need to be sealed. Even though the roots need total darkness, the rest of the plant does not. Make sure the plants get enough sunlight or look into artificial lights if setting up this system indoors. This whole system is compact and light in weight, therefore it could be a great option for someone living in an apartment, as it can simply be set out on the deck and brought in when it gets cold.

Chapter 5: The Hydroponic Drip System

What Is the Hydroponic Drip System?

The hydroponic drip system is likely the most used hydroponic system in the world. Much like a drip irrigation system used in regular soil, the hydroponic drip system brings a water-based nutrient solution to the root system of plants. With the low flow, this system is very efficient. When the water is slowly dripped at the base of plants, there is very little evaporation, and it is more like natural rain falling from the sky. Because this system mimics a very natural process, is simple, and very efficient, it is used by people living in tiny apartments, families wanting to grow food in their yards, and even large commercial farms.

This system can easily be used for plants in separate containers all in a row, or also used for vertical farming. Going up can substantially save space, especially if one lives in an apartment. In a vertical system, drip emitters are only needed at the top. The water trickles down, watering the plants along the way, and collecting at the bottom to be returned to the reservoir.

There are two types of hydroponic drip systems: recovery systems and non-recovery systems. A recovery system sends the nutrient solution through several times. Although this recycled solution can mean savings in the water and nutrient department, it requires a bit more monitoring and upkeep. The pH and nutrient levels will change in the discarded solution as the plants use it. This means that the pH level might need to be modified, and the nutrient solution might need to be emptied out and replaced with a fresh batch.

Non-recovery systems only send the solution through once, which may sound wasteful, but they are actually often more efficient. However, this is only accomplished by having very precise drip cycles. By using timers, and individualizing a drip for each plant, nearly every drop of the solution can be used. Since the solution is not being recycled, the reservoir will just need to be refilled with fresh solution, so there is no need to go crazy monitoring the pH and nutrient levels like in the recovery systems.

All things considered, this is a very simple system that is not very fussy. Some other set ups will fail if the power goes out or has some other issue. This system is also very efficient and versatile. It can be used on the balcony of an apartment or in a huge commercial operation. Large plants such as squash and melons can also be supported in the hydroponic drip system. Most other systems can only support smaller plants.

How to Build a Hydroponic Drip System

As with most other systems, there is certainly a kit that can be bought, but it is much more fun and cost effective to build your own. Here are the things that will be needed and a few details in how to set everything up.

1. Find a suitable container. There are several options for this. Choose one large container to hold all of your plants, separated containers for different types of plants, or a small, individual container for each plant. Whichever is used, make sure that there is a way for the nutrient solution to drain out of the bottom and either get discarded or sent back to the reservoir to be used again.

2. Choose a growing medium. The plants need to be supported in this system by something that can hold water and air while also providing adequate drainage. River rocks can be placed at the bottom of the grow containers and media such as rockwool, clay aggregate, or coco coir are good choices for around the plants.

3. Search for a good container to use for the nutrient solution reservoir. This should be a closed container that is dark in color and does not pass light easily. This is to ensure bacteria and algae growth do not become an issue. Put the reservoir in a place that is easy to get to and refill.

4. Grab a submersible pump. There are many options for this, as it does not need to be high powered. Use a fountain or pond pump, or consider an aquarium pump. An air stone can also be added to make sure the roots are

getting enough oxygen. This will help the plants to grow faster, because the roots will be able to absorb more nutrients.

5. Get a timer for the pump. This will allow the pump to go on and off several times a day. For most people, this does not need to be precise. However, if the plan calls for a sophisticated non-recovery system that aims for maximum efficiency, a precision cycle time will likely be needed.

6. Rummage around for irrigation tubing and fittings, or go to the store to pick some up. As with many other aspects of this system, there are many options depending on what is desired. PVC, thin spaghetti tubing, flexible tubing, or regular drip irrigation supplies can be used. Each plant will also need one nozzle or drip emitter to deliver the solution. Although, another very simple option is to lay out some tubing with little holes poked in it to deliver the solution to each plant.

For anyone who has limited space or would just like to set up a hanging garden or “living wall” in their home, a vertical garden could be a good idea. These can even be made with recycled materials such as plastic bottles. These can be made super simply with soil and regular water, or built using growing media and a drip system. Place a drip at every plant or only at the top, and allow the water to flow down to the plants below.

Maintaining a Hydroponic Drip System

It is very important to take good care of the drip emitters in this system. Clogged emitters are the biggest problems in a hydroponic drip system. This can happen because of matter in the liquid solution, or dripper tips becoming plagued with mineral build up or algae. To keep these problems at bay, check the emitters often and tap them to knock off any sediment. Also closely watch the pH levels of the nutrient solution. Read the directions carefully to make sure all nutrient get fully dissolved. Clean everything out very well in between growing cycles. Rinse and sanitize the growing medium, and also use nitric acid to flush out the irrigation system. This well help prevent bacteria and algae from building up.

Besides the emitters clogging, the biggest headaches of this system are keeping an eye on those pH and nutrient levels in recovery systems, or setting up the precise timing and delivery in a non-recovery system. All things considered, this system is very user friendly and versatile. Set up a large area this way in your backyard, get something going on your deck, or plant a wall of herbs in your kitchen. The possibilities are really endless.

Chapter 6: Ebb and Flow

What is Ebb and Flow?

Ebb and flow is also known as flood and drain hydroponics. This system delivers the water, nutrients, and oxygen to the roots of the plants in cycles. The growing area is flooded with the water and nutrient solution, and then drained. Flooding occurs and then the growing medium is allowed to dry out before the flooding happens again. This works well because the roots of the plant are forced to grow to search for moisture. The more a plant's root system grows, the better it can absorb the nutrients and the faster the whole plant will grow.

This system is an intermediate system and quite popular. It is very popular because it is easy to build, does not include any special or expensive parts, and can be made compact for a small space or quite expansive for a large one. This system is also very efficient because the nutrient solution goes through the system several times, and is not just discarded after one journey. This also means that as long as everything is set up properly, the system can run unattended for days or weeks at a time. Just be sure to set everything up for the current stage of the growth cycle the plants are in.

A final advantage of this system is that it can support medium to large sized plants. Tomatoes, beans, and cucumbers respond quite well to the ebb and flow system. They especially like their roots to be able to dry out when in the flowering and fruit bearing stages.

How to Build an Ebb and Flow System

There are many different ways to build this system, but they can be purchased ready to go. Go all out and get a table with a tray. This could look sleek and work well. However, a good place to start for beginners is with plastic bins. This system is quite inexpensive, and it will allow the chance to get familiar with all of the components and how it works before upgrading.

Here is a list of the supplies needed:

- Black or dark colored storage bin tote, 16-20 gallon size
- 30 quart clear tote (this should be shallow and about the same size as the lid of the dark colored tote)
- Mechanical garden timer that can run for 15 minute increments
- Aquarium air pump
- 6 feet of airline tubing and a “T” connector
- 5 inch air stone
- (4) flower pots (8” pots were used in this particular system. Feel free to use more smaller pots if that fits your need better)
- Small bag of perlite
- About 18” of ½” inner diameter black irrigation tubing
- Small submersible pond pump (120 gph)
- Fill and drain fitting set with one extension (it is best to order a real kit that is truly meant for an ebb and flow system, and these can be found online)
- Brick of coco coir

- Small bag of LECA (Hydroton of clay balls)
- pH test kit
- Desired number of bottles of nutrient concentrate

Tools Needed:

- Power drill
- Hole saw
- 3/8” regular or spade drill bit

Ask around to see if any friends have these tools, or buy them. If hydroponics is a sincere passion, these tools will likely come in handy again.

Instructions:

1. Cut two 1 ¼” holes in the middle of the clear tote. The holes should be close together, and the pots will need to be placed around these holes.

2. Set the clear tray (tote) on top of the lid for the other container. Center it very carefully. Mark the exact center of each hole onto the black lid with a marker. Cut two 1 ¼” holes in the black lid right where they will line up with the clear tray set on top.

3. Cut two more holes of the same size (1 ¼”) into the black lid. One should go on the far right side in the middle and the other should go in the top left corner. One of these holes is for the pump plug and bubbler tubing to go

through, and the other is to peek through to check the fluid level and to add nutrient solution through.

4. Grab your two drain fittings and screw them into the center holes of the clear bin only. Keep in mind that the rubber gasket goes on the underside of the bin. Just tighten them as far as possible with your hand; no need to use tools. Place the extension on the overflow tube (the over flow tube is the one that is thicker).

5. Now, set up the pump. Place the 1/2” irrigation tubing over the water pump outlet fitting. Hopefully this will be a snug fit; if not it may need to be secured with a zip tie. If it is too tight, hollow out a bit of the tube with a razor knife.

6. Put the clear tray that now has the drain fittings attached on top of the black lid. The holes should line up perfectly and the fittings should drop down through the lid.

7. Place the pump in the bottom of the black/dark tote, which is the reservoir. The black tubing will need to attach to the port of the shorter drain tube. This tubing will need to stay straight when the lid is on, so it will need to be trimmed. Measure, cut, and try a dry run before calling it good. When the length of the tube is satisfactory, push it over the drain tube and make sure it is secure. If the fit is not snug, use a zip tie to hold it there. It is very important the tube does not slip off.

8. Place the bubbler stone into the bottom of the black/dark tote, and push the tubing and power cord up through the side access drill that has been

drilled earlier.

9. Place the lid on top and snap into place.

10. Grab a stick or wood dowel to make a “dipstick.” This will allow you to measure how much solution is currently in your reservoir without having to take the lid off. As you fill the reservoir with water and nutrient solution, mark the “dipstick” at every 2 gallon measurement.

11. Make sure the setup is sitting on a level surface. Fill the reservoir up with 10 gallons of water. Do not forget the mark the “dipstick” after each increment of 2 gallons. Next, add the nutrient concentrate that you have chosen. If using Flora Grow, Flora Micro, and Flora Bloom (which are very good choices), add 10 teaspoons of each in the order listed.

12. Adjust the pH solution with your test kit.

13. Plug in the bubbler and pump and test the system. Make sure everything is working as it should and that there are no leaks.

14. Now it is time to get the plants in there! Check to make sure the pots fit properly in the bin.

15. Drill several ¼” or 3/8” holes all the way around the sides of the bottom of the pots. This will allow for good fill and drainage of the nutrient solution.

16. Fill up the pots with your chosen hydroponics medium. A good choice would be to place an inch or two of LECA (Hydroton or clay balls) in the bottom of each pot. This larger substance keeps the medium from flushing out of the drain holes that were just drilled, and is just an all-around great sublayer. On top of the sub layer, fill up the rest of the pot with a 50/50 mixture of coco coir and perlite. This particular mixture really holds moisture well and provides aeration.

17. Place seedling plants into the pots, and make sure the medium is packed nice and snug around it so it is held in place. Seeds cannot be started in the ebb and flow system because the moisture does not reach the top of the pot. They could never be kept moist enough to germinate. There are a few options for starting plants. Get them going in grow cubes or pellets, or just buy store bought seedlings and rinse the dirt off of the roots before placing them into the pots.

18. Water the plants from the top for the first few days, just to get them used to their new place in the ebb and flow system. Also, be sure to watch the system closely during this time period, to make sure everything is working properly. If a little water remains in the bottom of the tray after the drain cycle ends, the pots will need to be raised up so that they are not sitting in standing water. If they do sit in standing water, the roots will likely rot, and that is definitely not good. Put something under the pots to raise them up about ½". Something that is plastic usually works well so that it does not add any chemicals to the system.

19. Plug the water pump into the timer. Set the system to fill three times a day for only 15 minutes each cycle. Filling at 6 am, noon, and 6 pm works

pretty well. Plants like to rest during the night, so let them be.

20. Leave the bubbler pump with the air stone going all day and all night. This aerates the nutrient solution and keeps it from becoming stagnant.

Keep the system in a sunny window or outside during the day, to give the plants the best light possible. If it is going to be indoors away from windows, a light will be needed.

Maintaining an Ebb and Flow System

Be sure to keep the reservoir cool, between 55 and 70 degrees. Also watch the nutrient and water situation in the reservoir. Water will need to be periodically added. Keep track of how much water is added as levels drop. Once five gallons has been added, stop adding more water. Let the water levels continue to drop, and once the pump begins sucking air, drain the bin completely, mix up a new batch of nutrient solution, and start over again. Every new 10 gallon batch should last about 3-5 weeks if the above mention system of topping off is used. This is a good place to start, but keep in mind that this plan might need to be modified for your exact situation. Also, remember to keep an eye on pH levels.

A few other issues to watch for in the ebb and flow system are algae and pathogens in the open growing container. These issues need to be taken care of right away so that the growing environment does not become unhealthy. The timing of the system may also need some tweaking. Watch the plants and make sure they are happy. If things are not going well, reach out to an experienced hydroponic gardener for help.

Chapter 7: Nutrient Film Technique Hydroponic Gardens

What are Nutrient Film Technique Hydroponic Gardens?

Nutrient film technique hydroponic gardens are actually a very similar system to ebb and flow. The difference is that the nutrient solution is continually flowing over the roots, instead of being allowed to be drained off. This works because of a great thing called gravity. The grow tray in this system is placed at an angle so that the water can be pumped in at the top of the tray, flow down, drain out at the bottom of the tray, and be sent through the system again.

Nutrient film techniques got its name because the nutrient solution flows as a thin film over the roots. This means that they are well fed, but not completely soaked. The upper parts of the roots stay dry and get plenty of air and oxygen. This system works best for plants that are light weight and grow fast. Proper support systems such as trellises would be needed for larger plants. Since the roots are free hanging and not supported by a growing medium in this system, a top heavy plant would not work very well.

How to Build a Nutrient Film Technique Hydroponic Garden

There are many possibilities for building your own nutrient film technique hydroponic garden. Smaller systems using a tray, similar to the ebb and flow system, can be constructed. These could be great for indoors or smaller spaces such as a deck. However, the instructions that follow are for a really cool, large outdoor system. This can truly turn your backyard into a high yield farm if you build several of these units.

Here is a list of the supplies needed:

- (8) 8-foot 2x4s
- (3) sawhorse brackets
- (18) metal curved plant hangers with screws
- (8) 3” PVC pipes in 10 foot lengths
- 3” PVC shorter sweep elbow
- 3” PVC pipe end cap
- 6 feet of ¼” black tubing
- 70 gallon container with cover to serve as the reservoir
- Submersible pump (550gph)
- 10” pump bag
- (120) 2” netcups
- (120) 1.5” rockwool plugs or accelaroot starter plugs (or desired grow media, enough to fill the (120) 2” net pots)

Tools Needed:

- Drill
- 1.5” self-feed bit

Do some research and decide on the nutrients you would like to use on your system. A few good choices would be FloraGro, FloraMicro, or SOS Beneficial Bacteria.

Instructions:

1. Connect the 2x4s to the sawhorse brackets so that there are 3 sets of A-frames.

2. Dig holes where you would like to set up the system. Place the A-frame sets at no more than 3.5’. Bury each leg of each A-frame about a foot deep at an angle.

3. Attach one of the remaining 2x4s across the top of all three A-Frame sets. This will stabilize everything and give a solid frame to work on.

4. Grab the metal plant hangers and screw them in to the A-Frame sets at a gradual angle, at no more than a 2% gradient, so the water is not gushing down the system.

5. Drill holes that are 1.5” in diameter in the PVC pipe, about 6” apart. This will allow the 2” net pots to sit in the holes without falling all the way through. When finished, there should be about 120 holes.

6. Place the PVC pipes on the hangers. These may need to be cut as they reach the end of the A-frame. Use the sweep elbows to connect the pipes as they zig zag down the A-frame structure. It may be good to use some waterproof PVC glue to fasten the pipes to the elbows just to make sure there is no leaking.

7. At the end of the run, tighten the short sweep elbow to the end of the pipe. This will go into the water reservoir.

8. Drill a ¼" hole in the end cap and place it on the front of the very first PVC pipe at the top.

9. Push one end of the ¼" tubing into this hole and connect the other end to the pump. Put the pump in the pump bag and ensure the tubing and pump cord are going through a hole in the reservoir cover.

10. Place the short sweep elbow over the port of the reservoir cover. This will get the water flowing back into the reservoir. It could be a good idea to bury the reservoir so that the summer heat does not affect the solution in the reservoir; it is best to keep this cool.

11. Fill the reservoir with water and nutrient solution. Also, check the system pH and adjust accordingly. Plug in the pump and test the system to make sure everything is working properly.

12. Place one net pot in each hole and add growing medium as well as seedlings. This system does not really allow to grow plants from seeds, as

the water never reaches the top of the pot. Top watering may be needed for a few days just to get the plants established.

Maintaining a Nutrient Film Technique Hydroponic Garden

Keep in mind that this system works best for plants with small root systems. Greens and herbs are really good choices. Plants that grow large or just have large root systems will clog it. Start your own seeds elsewhere or purchase seedlings from the garden center. If you buy seedlings from the garden center, just gently wash off the soil from the roots. Then, it will be ready to go into the growing medium, and the roots should hopefully be long enough already to reach the nutrient film running by.

A Nutrient Film Technique Hydroponic Garden System needs to run 24 hours a day. The reservoir should be completely flushed, cleaned, and stocked with a fresh batch of nutrient solution every two to four weeks. Between these times, keep an eye on the pH and nutrient levels in the water. Also, make sure to take out any plants that are getting old and may have large root systems that is clogging the system. Plants grow fast and really well in this system. With 120 holes, this system will provide a high yield. It is best to plant a variety of things so that you do not end up with a freezer full of just one thing.

Chapter 8: The Best Plants to Consider Growing in a Hydroponic Garden System

The types of vegetables you would like to grow can often point you to the system you should start with. Some systems can handle larger plants better, and others really need smaller plants. Think about the vegetables your family loves and what you buy the most at the grocery store. This is probably where you should start. Hydroponic gardening can produce a very high yield, so make sure you are producing things you really want to eat. Also, think about vegetables that taste the best fresh picked. Home grown tomatoes are infinitely tastier than those in the supermarket. Root vegetables do not taste much different at the store, and they are not very practical for a hydroponic system anyway.

Shy away from plants that are space hogs. Zucchini, melons, squash, and corn really like to spread out. They will take over everything. This is especially true if you are gardening indoors, on a deck, or in another small space. If you are going for it in the backyard or in a greenhouse, feel free to support those vining plants, and let them grow all the way to the ceiling.

There are five plants that do really well in a hydroponic system. If you are totally new to hydroponic gardening, start with these plants. Once you get the hang of them, branch out and try some other options.

Lettuce (and most other greens)

Get ready for some salad! Leafy greens are terrific things to grow in a hydroponic system. They have a shallow root system and the plants themselves do not get very tall. This means there is no need to support the plants. These plants are also very fast growing, so you could walk over and grab some lettuce to add to a salad for dinner every day. Consider staggering your plantings and varieties so that there is always lettuce ready to go. The grow time is about 30 days and the best pH is 6.0 to 7.0. There are many varieties to choose from that do very well, including Bibb, Romaine, Buttercrunch, Iceberg, and Boston.

Spinach

Continue the salad trend with some spinach. This plant also grows very fast in a hydroponic system, especially one that keeps the nutrient solution highly oxygenated. Much less water will be used growing spinach in a hydroponic system rather than in the ground. It is also easy to start spinach as a seed and then move them into the system after sprouting. The grow time for spinach is about 40 days and the best pH is 6.0 to 7.5. There are also many varieties of spinach, so try as many as you can. Munch on Red Cardinal, Savoy, Smooth Leafed, Regiment, Bloomsdale, Tyee, and Catalina. It is also possible to make the spinach taste sweeter by keeping grow temperatures low, between 65 degrees and 72 degrees.

Who doesn’t love strawberries? Fresh red strawberries in the summer are so juicy, sweet and delicious. However, strawberries from the grocery store in the winter are bland, hard, and go bad really fast. Therefore, it is an amazing idea to grow strawberries year-round in a hydroponic garden. Strawberries grow really well in larger quantities in an ebb and flow

system. Smaller crops also do great with deep water culture or nutrient film systems. Harvesting strawberries in the soil is also super tedious with all that bending over, but harvesting in a hydroponic is pretty easy. Grow time for strawberries is about 60 days, and the pH should be between 5.5 and 6.2. Never start with strawberry seeds, as these take years to be ready. Instead, buy cold stored runners that are ready to go into your hydroponic system. There are many varieties of strawberries such as Tioga, Chandler, Red Gauntlet, Brighton, and Douglass.

Bell Peppers

Even though these plants can get quite large, they work very well in hydroponic systems. Just be sure to prune the plants at about 8 inches so they do not get too big for the system. Peppers do best in deep water culture or ebb and flow. The grow time for peppers is about 90 days and the best pH is 6.0 to 6.5. Bell peppers do best when they get a lot of light. Place in a spot that gets prolonged sun if growing outside, or be sure to have a light on them for up to 18 hours if growing them inside. Just adjust the light as the plant grows, and always keeping them about 6 inches above the plant. A few varieties that you might want to try are Yolo Wonder, Ace, Vidi, or California Wonder.

Herbs

Herbs are a really great place to start when learning about hydroponics. They do well in pretty much any system. There are many varieties of herbs to try, so you can easily fill up all of your pots with different types. Many also say that herbs grown in a hydroponic system are much more flavorful

and aromatic than those grown in the soil. The grow time and pH vary by plant, so you will want to look those up once you have decided what to grow. There are many choices, such as watercress, basil, parsley, thyme, cilantro, mint, rosemary, dill, and oregano. If there are others you love cooking with, look them up and find the details for growing them. One tip for growing herbs in a hydroponic system is to flush the growing medium once a week to get rid of nutrients that have not been absorbed by the plants.

Chapter 9: Other Useful Resources and Information

It is truly amazing what can be found on the internet these days. Do some of your own research and read some more about hydroponics before diving in. This book also showed one particular way to DIY each system. There are other methods out there as well as plenty of ready-made systems to purchase. It is easy to look up information on any particular plant you would like to grow to find tips, pH levels, and more.

Make friends with someone at your favorite garden center. Ask around and find someone in your community who knows all about hydroponic gardening. Sometimes, a person who is available to answer questions and show things face-to-face can be really helpful. Once someone gets hooked on hydroponic gardening, they will be happy to share their knowledge with anyone ready to listen.

Here is a little bit more information about lighting in a hydroponic system. Of course, as stated, the best lighting source is the sun. Plants generally need 4 to 6 hours of direct light ,plus 8 to 10 more of bright light. Make sure to place your hydroponic system accordingly. Outdoors is great, in a window is pretty good, and if these options are not available to you, then there are plenty of good lights on the market. Here are a few to look into.

T5 Fluorescent Laps

These are the cheapest lights you can buy for hydroponics, and they also run nice and cool. Just keep in mind that these lights work great for ornamental houseplants, herbs, and leafy produce such as spinach and lettuce. They can also be used for starting seedings, cuttings, or clones. This could be a good light to purchase for starting seeds inside and then transplanting them to your outdoor hydroponic system. These do not work well for flowering plants or fruiting vegetables; they just do not have the needed spectrum.

Here are a few other tips for using these lights. Keep them only four to six inches above the plants. Since they run cool, there is no worry that they will burn the plants. Make sure to have 40 watts per square foot of planting bed, and a good rule of thumb is one four foot tube per each two square feet of growing bed.

High Intensity Discharge (HID) Lighting Systems

These lights are very intense and have been used in commercial greenhouses for decades. Now they are easy to acquire and provide very good results in a home hydroponics garden. HID lighting systems provide the needed spectrum for fruiting and flowering crops. It is very close to what the sun provides outside. The only downsides are that these lights are expensive and run hot.

There are two types of HID bulbs available, metal halide (MH) and high pressure sodium (HPS). An MH light is adequate for most vegetables in all stages, but an HPS light is preferred during the flowering/fruiting state of plants. It is preferred, but not necessary. If you can only afford one light,

definitely get a metal halide. Even though these bulbs are expensive, the good news is that they last for years.

Light Emitting Diode (LED) Grow Lights

Until recently, this new lighting technology has not really been suitable for grow lights. These are a good choice now because even though they cost more upfront, use way less electricity than traditional lighting, run cool, and last a very long time. Just be careful about what you buy. There are some cheap LED setups out there that are claimed to work for growing, but often they do not have the needed spectrums for hydroponic gardens.

At the very least, buy a mid-range LED panel that is specified as a 5-band or 7-band. However, a high-end LED grow light will yield the best results. One to look into is the California Lightworks SolarSystem 550.

In addition to lighting choices, there are also a variety of options for adding nutrients to your hydroponic garden. There are 16 elements that hydroponically grown vegetables need. Carbon, hydrogen, and oxygen are taken from the air or aerated into the solution, but the other 13 need to come from a nutrient solution. These 13 are molybdenum, copper, boron, zinc, manganese, iron, chlorine, magnesium, calcium, sulfur, potassium, phosphorus, and nitrogen. There are many pre-mixed solutions on the market. Several good ones were mentioned earlier on in this book, but some serious gardeners even mix up their own.

Conclusion

Thank you for taking the time to read *DIY Home Hydroponics for Beginners: The Essential Guide to Turn Your Backyard into a Farm*, and let's hope this book has provided a good beginning understanding of hydroponics.

The next step is to process the information from this book and come up with a plan. Think of what materials you may already have on your property to make a hydroponic system a reality. Also, think about the types of plants you would like to grow and what system would best support these plants. Another thing to consider is where the hydroponic garden will go. Do you truly hope to turn your entire backyard into a farm? Or, do you just have a small window or balcony to devote to hydroponic gardening at the moment?

Once a plan is developed, do a little more research or refer back to this book to build a system and get plants into it. Ask around on social media to see if any friends have experience in this area. Search for a local hydroponic gardening store in your town and pay them a visit. The staff could certainly answer questions and get things underway.

Our planet is changing quickly. We need to think about more sustainable ways to grow food. Many commercial farming operations have already seen the amazing benefits of these systems. Grow more food using less resources. Growing hydroponically also allows people to use fewer

chemicals and pesticides. Control exactly what goes into your body by having control over the way plants are grown.

Hydroponic gardening is also a very relaxing hobby. Get back in touch with nature after a stressful day or week at work. Return to your home after sitting in the car for hours in traffic, and check on your plants. Put a smile on your face when you see how much they have grown since just yesterday.

This is also a hobby that can bring the whole family together. Spend quality time together planning and building the garden. Talk about the vegetables that everyone loves to eat, and decide on the best seeds to start or seedings to purchase at the store. Watch the joy your children feel when plants start to sprout up and bear fruit. Share in it with them and also teach them how to troubleshoot problems when they go wrong with your system. There are many great lessons in hydroponic gardening. Lastly, beam with pride when everyone sits down at the dinner table to enjoy a meal made with fresh vegetables from your own garden. Family time around the dinner table is some of the best time.

Finally, if you found this book useful and informative, please share with friends, and a review on Amazon is always appreciated!

Sally R. Ball

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