

GUIDE TO HYDROPONIC GARDENING



HYDROPONIC GARDENING

GROWING FOOD WHEN YOUR SOIL ISN'T UP TO THE TASK

Hydroponic gardens are nothing new. The famed “Hanging Gardens of Babylon”, one of the lost wonders of the world, were a massive, elaborate hydroponic gardening project. Hydroponics is perfect for either growing plants in an environment where they wouldn't normally take or areas where the local soil isn't up to the task.



The real point of hydroponic gardening is to get your plants all of the nutrients they need without any pollutants. If you live close to a mine, an industrial plant that dumps dubious things into the local water supply, or the site of a recent natural disaster, your topsoil

may be missing or your soil itself may have too many toxins for your plants to thrive. Don't let that stop you from eating.

The silver lining behind the dark cloud of bad soil is that a lot of plants love being in a hydroponic environment. Vegetables, common kitchen herbs, and spice-bearing plants grow between 30-50% faster in a properly maintained hydroponic setting than they do in the soil. If you're in a position where you have seeds and a hungry family, hydroponics can be faster, safer, cleaner, and easier to protect than growing in soil.

In its most basic form, a hydroponic garden needs a container for water, nutrient powder, an air pump (just like the ones you see in home aquariums), and something nice and solid for the plants to hold onto.

Hydroponics may seem like a lot of work, but believe it or not, hydroponic gardening is simpler than most modern farming. Growing food has never been easy, but today it's more in your control than ever before.

MINIMUM TOOLS NEEDED

In a truly desperate emergency situation, you can make a small hydroponic gardening container out of a large plastic tub with some

holes cut in the lid, an aquarium bubbler, fresh water, and a bag of plant nutrients. In fact, if you're setting up an outdoor hydroponic garden, you don't need much more than that. The wind and sun will take care of the humidity and lighting.

In addition to your large plastic tubs, you're going to need a source of light, a source of heat, ventilation fans, and a "grow" medium. The light source will substitute for the sunlight they're missing outside. The heat will keep your plants warm in the winter. The ventilation fans will keep the humidity at a reasonable level. Finally, the grow medium gives your plant roots something to cling onto in place of soil.

THE PROPER ENVIRONMENT

You can set up your hydroponic garden either inside or outside. If you set up your garden outside, you get plenty of natural sunlight, your plants are still off the ground and above the climbing height of many insects, and, by avoiding the soil, the plants are less likely to come into contact with fungus or other plant rot diseases. You can simply set your hydroponic gardening containers up in a sunny spot of your choice and carry them inside during bad weather that might harm the plants.

You can also take a half and half approach—

leaving the plants outside during spring, summer and early fall, then taking them inside before the first hard freeze, keeping them safe and warm indoors through the winter.

However, if you want to grow consistently-sized and healthy plants year round, you're best served setting up your garden indoors. Controlling the environment means that not only will you never have to worry about using pesticides, but your plants will also have a lowered risk of catching soil and pollen-based diseases.



There are three major factors you need to keep in mind when setting up a grow room: temperature, humidity, and carbon dioxide. You'll need to be able to maintain all three of these things at a steady level to keep your plants in good condition. Remember, if you ever feel as though you need to hit the reset button, you can always carry your plants

outside, air out the room, and start over from scratch. There's no need to stress!

To set your grow room up, the first thing you'll do is empty out all of the furniture, paper, electronics, and anything else that reacts poorly to moisture. The last thing you want to do is print up instructions on how to maintain your plants and discover, two weeks later, that all the ink has smudged off the page because the air itself is so moist. You can store moisture and rust-proof things in your grow room, but really not much else.

It gets moist because you're growing your plants in water that is constantly being aerated to add oxygen. A lot of people think you have to add moisture to a grow room, but the opposite is true. Your struggle will be getting moisture out. The best way to do this is to set up a ventilation system. You want fresh, clean air coming in one end and your humid, warm air going out the other. If you have time and money to set up a growing system in advance, there are numerous automated fans you can buy with internal humidity sensors. However, if you're in an emergency environment where you have limited power and need to grow food fast, you can make due with a shop fan set at ground level to help circulate air around the room, a box fan in one window aimed outwards to suck in outside air, and another box fan at the opposite end of the room (preferably on a parallel wall) aimed

to blow air outwards. In most climates, you'll probably need supplemental heating sources in winter. Depending on your electrical situation, this could range from a wood-fueled Chimenea in the corners to central heating.

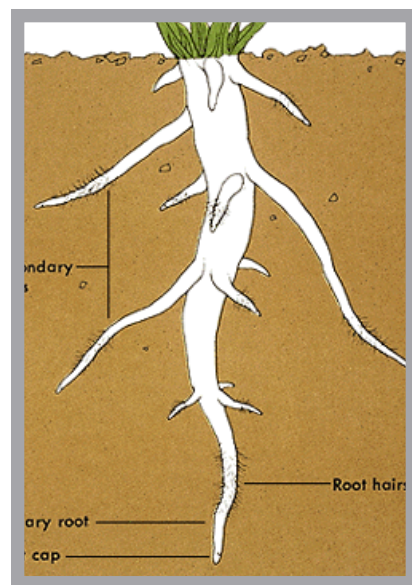
SETTING DOWN ROOTS

Your plants can survive without soil, but their roots still need something to cling onto. You might think if you're going

to the trouble of putting your plants in a soil substitute, why

not just grow them in the dirt? The answer is control. When you grow hydroponic plants, you keep them away from bugs and disease, you give them more nutrients than they would have access to in the soil, you give them more light than they would have access to from the sun. Hydroponics put you in control over all the things farmers have to worry about day-to-day.

The medium that you grow your plants in is basically there to give the roots something to hold onto in order to keep your plants



growing up straight and tall. You have a lot of options for a soil-less mix. “Soil-less” literally means anything that isn’t made from dirt.

Coconut Fibers

Coconut fibers are made from ground up coconut husks. They’re all natural, hold water well, have some root stimulating hormones, and have been found to be a very good medium when mixed 50/50 with clay pellets. A lot of hydroponic gardeners swear by them. They’re quickly becoming one of the most popular mediums for growing just about any type of plant.

One caution, though: with coconut fibers, you get what you pay for. The cheaper ones have been found to be mixed with sea salt to bulk them out. Pay a little more for a better product. Your plants will thank you.

Clay pellets

These are exactly what you expect—small, rough, kiln-fired pellets of clay designed

to give your plant roots something to hold onto. They don’t hold onto water very well at all, so they’re best used when mixed with something else. Clay pellets and coconut fibers are your best bet for starting a brand new hydroponic garden.

Perlite

Perlite is a very inexpensive form of volcanic glass that has been used in gardening for decades. People use it for soil aeration in traditional gardening as well as hydroponic gardening. However, it dries out very quickly and once dry, is it harmful when inhaled. Wear a mask when dealing with perlite.

Vermiculite

This mineral has the opposite drawback to perlite. Vermiculite retains way too much moisture to be used on its own. However, a 50/50 vermiculite/perlite mix can get you a good balance of moisture for your roots while reducing the overall toxicity to humans.



Rockwool

Rockwool is made from taking igneous rock, melting it until it becomes a liquid, then spinning it out like cotton candy. The end result is something with a lot of little nooks and crannies for your roots to hold onto. The drawback is some of it will break into a fine powder when you first set it up. This powder is not only dusty and cumbersome to clean up, but also bad for breathing. Wear a mask when handling it. Silica Rock Silica rock is a gritty, silicon-based rock that is dried in a kiln to harden it and change its physical properties. It has the advantage of retaining water well, but the disadvantage of constantly shedding dust until it's nothing but a fine powder. It needs a constant, strong rinsing, so is best used with more advanced systems.

Grow Cubes

If you don't want to worry about mixing your own growing medium, there are a lot of different brands of pre-manufactured grow cubes. Most of them are a custom blend of the mediums listed above. Feel free to experiment with different grow cubes in different containers until you find just the right mix for your plants. Grow cubes also store and stack well over time, so if you have limited space and want to stock up for the future, they're a good buy.



Containers

Now that you've picked your plant medium, you need a container where your plants can grow.

Plastic Tubs

The cheapest, easiest, and most often used containers are big plastic tubs. Most people pick the ones around three feet wide by two feet deep. These are a good size for remaining stable under the weight of the water. They're also about the maximum size for portability, so if you might need to rearrange your grow room or don't want leave your plants outdoors for the most part, bringing them in only during rough weather, don't go any larger.

Directions: Fill the tub about $\frac{1}{2}$ full of your growth medium. Fill it the rest of the way to the top with water. Add in a hose for your aerator and you're good to go.

Cut half a dozen large holes in the lid of your plastic tub plus one smaller hole to add nutrients. Carefully slide your plants in place so that the roots dangle down into the water. As long as you keep the water oxygenated and full of nutrients, you shouldn't have to do much maintenance on these simple systems. Go ahead and line them up around your grow room however you see fit. You can usually fit quite a few of these rectangles into a densely-packed space.

Plastic Pipes

If you know your plants will never see the outdoors and you're secure with your current location, you can set up a hydroponic pipe system instead. In this case, instead of growing your plants in tubs, you'll set up a nice self-contained loop made from plastic pipes. You'll want pipes at least six inches across, preferably larger if you want to grow bigger vegetables.

Fill your plastic pipes about 1/2 of their width with your grow medium. Assemble them into a self-contained rectangle. You'll want to cut holes in the top where your plants will grow down into the water. You'll also want to have a hole on top for adding water, a hole on bottom for draining water (it doesn't need to be done often), and a hole for the aerator (your industrial-sized aquarium bubbler).

Plastic pipes can make for a very efficient use of space. You can nest one rectangle inside another or set up rows next to one another. Just make sure you leave enough space for a human to get in and out when watering, feeding, and harvesting the plants.

WATER QUALITY

It won't come as any surprise that you'll need to use high quality water for your hydroponic plants. If you have reasons to doubt the quality of your local water, a chemical or charcoal filter is your best bet. If you don't have access to those, there are some time consuming, yet effective things you can do to try cleaning out impurities.



Medieval brewers had to use water from the horribly polluted and downright disgusting Thames River in London. They purified water for beer making by first boiling it.

While waiting for the water to come to a boil, they would whisk together around 1 egg white per gallon until the whites were foamy plus grind the egg shells with a pestle. Once the water came to a boil, they added the ground shells and egg whites, and then stirred the whole thing rapidly. A dirty foam would form on the top of the water. They could then keep boiling and skim the foam off until the water came clean. This worked because the egg whites and shells would bind to particulates in the water and carry them to the top. Some home brewers still swear by this method today.

Once you're satisfied with the cleanliness of your water, you'll need to monitor the pH. Most plants can cheerfully grow in a pH anywhere from 5.8 to 6.8. In general, splitting the difference at 6.3 is considered ideal. If it's too high or too low, your plants will get sick.



Luckily, it's a lot easier to test water pH than it is to test soil pH. You can buy testing strips anywhere from pet stores to pool stores. Check your water about once a week. If the pH is too low, add a small amount of soluble potash. If it's too high, add a dash of phosphoric acid.

NUTRIENTS

Since your plants aren't getting nutrients from the soil, you have to add them manually.

Dry nutrients are notably cheaper than their liquid equivalents. There is a great deal of debate about which is more effective. Some hydroponic gardeners swear they see a huge improvement when they switch to liquid while others say you're only paying for the privilege of having someone else mix the chemicals for you. Everyone agrees liquid nutrients are easier to use. You just pour in the right quantity and walk away. Dry nutrients require carefully mixing, and sometimes it can be difficult to get the solution into a proper suspension in the water instead of having it thin on top and gritty on bottom.

This is another case where price usually makes a difference. The less you spend on dry nutrients, the more time you're going to need to properly mix them. The higher quality, more expensive dry nutrients are

still cheaper than the liquid nutrients and will blend easily. If stockpiling for an emergency, high quality dry is probably a better choice because you can store a larger quantity in a smaller space for a reasonable cost.

That leads you to the major issue of whether you want to purchase organic or synthetic nutrients. Organic nutrients are made from guano, potash, kelp, worm casings, and other byproducts of living things.

Synthetic nutrients are soluble chemical salts created to provide plants with all their nutrient needs.

The only real difference between the two is that organic nutrients are more likely to create subtle changes in the pH of your water. Either one will dissolve into nitrogen, magnesium, and the other chemicals your plants need to be healthy and happy.

If you have the time to set up an experimental hydroponic garden for tomatoes, herbs, or your favorite veggies, experiment with different brands and formulations of nutrients until you find what works best for you and your plants. A lot of hydroponic gardeners swear it's as much an art as it is a science. Keep in mind, their goal is to exceed the natural bounty expected by traditional farming, so in most cases, doing badly means only having a yield as high as that which a farmer achieves growing a crop

in the soil.

There is no question that you're best off using a commercially purchased nutrient solution. However, in a true emergency situation, you can make your own from 9 oz saltpeter (potassium nitrate), 7 oz Plaster of Paris (calcium sulfate), 6 oz Epsom salts (magnesium sulfate), 4 oz monocalcium sulfate, 1.5 oz ammonium sulfate, and ½ tsp iron sulfate. Wear a mask and gloves when mixing this and keep it sealed in an airtight plastic container. When feeding it to your plants, use 1 tsp per gallon of water.



LIGHTING

Your artificial lighting needs will vary a lot depending on how much natural light your plants get to soak up. If you've transformed your patio or a sunroom into your growing area, artificial lighting is just a supplement.

If you're setting up a hydroponic garden in a room with just a couple windows, you might as well treat it like a dark basement. You're going to need a lot of lamps.

Spotlight Lamps

These are the cheapest, easiest, and most common lamps. They're the same sort of thing you find hanging over your head at a restaurant. All you need is an inexpensive hanging lampshade (the cheap aluminum shape is a classic) and a regular incandescent light bulb. You'll end up with some warmer spots and some cooler ones as well as some plants with more light than others, but in an emergency, you can find some variation on this sort of lighting in any house. In fact, you can always unthread the cords from standing torchiere lamps, discard the standing rods and base, then hang the bulb and shade from the ceiling.

LED Grow Lights

These lights are typically small, easy to install, and relatively inexpensive. They contain two LED bulbs, one red and one blue. You'll usually need one grow light for each plastic tub or every three to five feet of plastic pipe. Between them, the light emitted simulates sunlight better than your typical incandescent bulb. By their nature, LED lights don't emit as much heat as traditional

bulbs, which makes them easier to handle and less likely to interfere with the overall heat and humidity balance of the room. What they won't do is help you see your plants well. You'll want some normal bulbs around for human eyes.



Metal Halide

Metal Halide bulbs glow a bright, intense white. Human eyes won't have any problem seeing these. They're considered one of the Best grow lights for entirely indoor hydroponic gardens because they do such a good job simulating the natural light spectrum and temperature. Depending on the size of your space, you probably don't need very many of them. They glow so brightly you can use one for every 3–4 spotlight lamps you would've used.

High-Pressure Sodium

If you think of different bulbs in terms of feeding your plants, Metal Halide is their chicken while High Pressure Sodium is their fish. Both are a good main course, but you want to mix it up every now and then to keep the palate interested. High-pressure sodium lamps heat up slowly, easing their way from a light pink up through a warm orange. Some plants respond very well to light of differing colors and warmth. Alternating between a Metal Halide and High-Pressure Sodium bulb every other week is a good way to give your plants the maximum amount of light to keep them healthy.

OPTIONAL ACCESSORIES

If you're doing emergency gardening with nothing more than a couple of box fans and some repurposed plastic tubs, be careful to keep small children and pets out of your gardening area. You can easily end up with a carbon dioxide buildup near the floor of your room which could effect the breathing of vulnerable little ones and four footed friends. Standing well above it, few adults will notice.

You can increase the safety and efficiency of your hydroponic garden with a few optional accessories.

Air Movement Control

Instead of a crude box fan system, you can invest in some active blower systems. Most of these require either cutting a hole in an exterior wall or modifying a window so you have access to the outdoors. You can buy plug-in air blower systems which will not only circulate the air around your grow room but will also draw in fresh air and vent stale air.



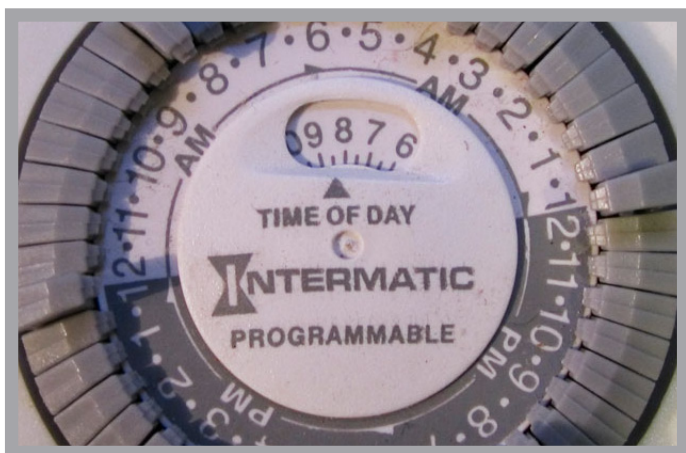
Dehumidifiers

These are the exact same ones that people use in coastal, humid parts of the country. You don't need to spend a lot of extra money on something specifically designed for a greenhouse unless it comes with extra, useful features such as CO2 monitoring. If the humidity is above 75–85%, your plants will have difficulty breathing. Since you're

basically filling a room with tubs of water then pumping oxygen into that water, a dehumidifier can go a long way towards keeping the air merely moist instead of downright swampy.

Temperature Control

If your room doesn't have individual temperature controls, there are wide assortments of space heaters you can set up with built in thermostats which will keep the room at a constant temperature.



Light Timer

If you're in a room with few to no lights, there's no reason to illuminate your plants on the sun's schedule. You can set up a timer so your plant lights are on anywhere from 12 to 18 hours per day. There are a lot of theories on what light/dark cycle works best for each plant. Once again, experimentation is key. However, for starters, try 16 hours of light to 8 hours of dark since that's what they

would receive outside during the height of summer.

FINAL NOTES

Don't feel pressured to spend a couple thousand dollars on a custom system. Ideal conditions are nice, but most hydroponic gardeners either have a couple plastic tubs they leave outside most of the year or a converted sunroom or porch where they grow a few plants for their own pleasure. Remember, setting up your hydroponic garden isn't a race. You can start small and build on your successes. Plants take time

to grow. While they grow larger and faster hydroponically, they don't go from seed to harvest overnight. Pay attention to what works in your specific indoor environment and work with it instead of against it.

Hydroponic gardens are best for people who have access to a steady supply of electricity. If that electricity is solar, don't stress about needing to shut down your systems after dark. Your plants will survive. The same is true for wind power. The wind has to be completely still for a day or two before you really have to worry about getting your plants outside and into natural light. Don't let an emergency situation talk you out of hydroponic gardening. If things are tough, hydroponic gardening could be just what you need for a sustainable source of fresh vegetables, herbs and spices all winter long.

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