Hydroponic Gardening Made Easy

Grow Fresh Delicious Produce From the Comfort of Your Own Home

ZeroSoilGardens

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Intro to Hydroponics

Hydroponics gardens have quickly grown in popularity among consumers and restaurants as a fresh alternative to store bought produce. If you've ever tasted a fresh, naturally grown tomato you're familiar with how much better tasting they are than the average tomato from your grocery store. That's because traditional farm grown produce is typically picked prematurely and artificially ripened during transport. Plus, most of the produce found in your local supermarket is generally bred for hardiness and appearance, rather than taste.

With all of the advantages of hydroponics over traditional soil based gardening its not hard to see why so many people are starting their own hydroponics gardens!

- ✓ Use up to 2/3 less water
- ✓ Provide higher yield per square foot
- ✓ Perfect for city dwellers and those that don't have backyards
- ✓ Eliminate damage from pesticides and other harmful chemicals
- ✓ No digging, weeding, or back breaking work
- ✓ Fresh produce can be grown year round

Hydroponics may seem a little complicated at first but once you learn the basics it really gets quite easy and fun. There are a couple of main factors that will contribute to the success of your hydroponics garden.

Growing Conditions

Whether your hydroponics garden is kept indoors or outdoors, a carefully controlled environment is essential to your garden's success. The three main

factors to giving your garden a good home are humidity, temperature, and air circulation.

Water and Nutrients Solution

Starting with good water is crucial to any successful hydroponics garden. With traditional soil based gardening the soil acts as a buffer and filter for any impurities that might harm your plants. In hydroponic gardening this filter is removed from the growing process so impure water or imprecise nutrient mixtures will have a direct negative impact on your hydroponics garden.

Lighting

One of the basic elements that plants need to grow. Assuming you're keeping your hydroponics garden indoors, you'll have to make sure you give your plants the necessary light they require to grow. This can be either a big, sunny windowsill or specialized plant lighting such as fluorescent, HID, or LED. The type of plants you end up growing will be a major factor of how much and what type of light you'll need.

Propagation

You'll have to decide if you're going to start your hydroponic garden using seeds or seedlings. If starting from seeds, which is the preferred option, you'll need a way to sprout them. There are several methods including using rockwool starter cubes, the most popular and common method, to help incubate your seedlings.

Medium

Since you're growing without soil, you'll need something else to hold your plant's root system together. The best growing mediums are chemically inert so they won't harm your plants or effect your nutrient solution, are inorganic so they won't breakdown and pollute your solution, porous enough to allow

sufficient oxygen and water to reach your plants, and large enough so it doesn't fall through the slits in your net pots. There are several popular options that will all give your plants the proper foundation for their roots to hold on to including hydroton, coco, and silica.

Measuring Equipment

The pH of your water will be a major factor of the success of your hydroponics garden. Most plants will only grow in a pH range of 5.5 - 6.5 so you'll need a way to accurately measure it and adjust it if necessary. Luckily, decent pH meters are fairly inexpensive as are the appropriate pH up and pH down solutions. A combination thermometer/hygrometer is a nice-to-have tool to make sure your temperature and humidity levels are in the optimum range. Electrical timers are a great way of making sure your plants are getting the optimal amount of light each day.

Growing Conditions

Replicating Mother Nature and giving your plants ideal growing conditions sounds like a big task but its much easier than it sounds. Plants want to grow and will grow if given the most basic of conditions - just like this plant growing out of a crack on a rooftop of all places! It's up to you to give your plants the most optimal of conditions possible so they can provide you with the most optimal harvest possible. Of course, the larger your hydroponics garden the harder this task becomes but with the proper equipment and planning there are no limits to what you can grow.

Humidity

Anyone who has ever been in a greenhouse would think they need to crank up the humidity for their hydroponics garden. With traditional soil based gardening this may

work best but your soilless garden is a bit different. High humidity will actually suffocate your plants and create a breeding ground for mold so you'll want to monitor your relative humidity levels. To maximize nutrient intake and promote optimal vegetative growth and flowering your hydroponics garden should be kept at a relative humidity range of about 40-80% with 50% being optimal.

A great tool to pick up is a combination hygrometer/thermometer that will allow you to keep tabs on your relative humidity and temperature. If you live in an area with naturally high or low humidity levels, or if you plan to keep your garden in an area of your house with high or low humidity levels, picking up a humidifier or dehumidifier may be a good investment.

Temperature

Plants are very sensitive to temperature and you must avoid extreme heat or extreme cold at all costs. The optimal temperature range for most plants is between 65° - 75°F. Sounds easy enough since you're growing indoors and this is the same range that most people enjoy but depending on the size of your garden, where you keep your garden, and what type of lighting you use, this may or may not be so simple.

If you only have a couple of plants and have a nice sunny window that will provide ample direct sunlight you can skip the rest of this. For those that have bigger things in mind though - keep reading! For larger gardens heat is going to be your #1 problem since you'll need supplemental plant lights and some of these lights produce a ton of heat. If this sounds like you here are a couple of tips to help keep your temperatures down:

- Make sure your garden has plenty of circulation and ventilation to vent away heat
- Open a window to allow cool air in and hot air out
- If needed consider a portable A/C unit
- Use grow lights with exhaust tubing and fan to vent away heat

Another thing to keep in mind is that there are warm season crops and cool season crops. Warm season crops such as tomatoes, peppers, and herbs enjoy a temperature

range between 70°-80°F. Cold season crops on the other hand, such as lettuce, grow best at temperatures between 60°-70°F.

Saving the best tip for last - plants are hardwired and have evolved to adjust for a natural drop in nighttime temperature of about 10°F. This nighttime period of darkness and coolness is basically when plants sleep and, like all living creatures, this sleep period is vital to help them function properly.

Air Circulation

Proper air circulation is a must for any hydroponics garden for a couple of reasons. Plants rapidly deplete the air of carbon dioxide so fresh air (and carbon dioxide) is a must. Air circulation is also vital in order to vent away any hot, stale air that may suffocate your plants. Lastly, a nice gentle breeze will do wonders to help stimulate growth.

If you're growing a couple of plants in an open area with natural sunlight or using lights that don't give off a ton of heat such as LEDs or Fluorescents, a basic standing floor fan set on low will do the trick. If you're growing in a closed space such as a dedicated room or closet using hot HIDs though you may want to look at more powerful methods depending on how hot your room gets. If you're able to keep the temperature moderate enough an open window and floor fan should be sufficient; otherwise you may have to invest in an exhaust fan similar to a bathroom vent fan.

Water and Nutrients Solution

Now that you know what kind of environment you'll need to have for your hydroponics garden its time to look at the basic elements that will make your garden thrive. The foundation of your garden is going to be the water you use - similar to gas and cars, the water you use in your hydroponic system is what will make it really go!

Depending on the mineral content of your water, you may or may not be able to use the water straight from your tap as your starting point. Since there is no soil to act as a filter for your plants they will absorb whatever is in the water you give them - if the water you start with has a

high ppm count (parts per million) they'll absorb all these mineral particles as well as the nutrients you give them. Worse yet, nutrient/mineral lockout may occur and they may not even get the nutrients you intend to give them!

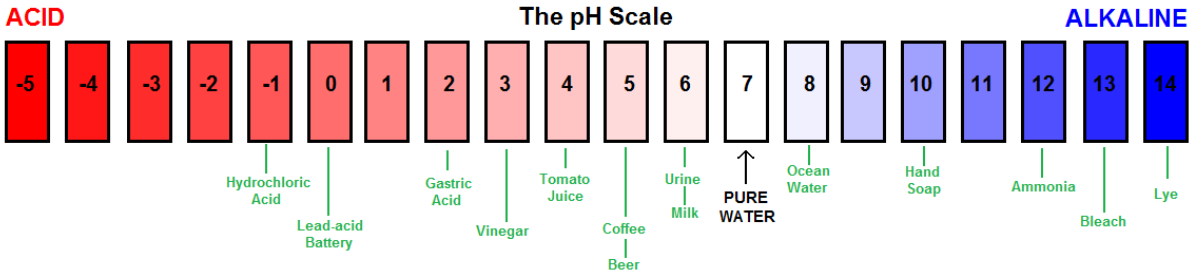
Having your tap water checked is pretty straightforward and cheap. You can sometimes find free test kits at your local hardware store that you can mail in or you might even be able to call your water company and ask. If you really want to get crazy they also sell ppm test kits and tools that allow you to measure this yourself. If your ppm is above 300 your best bet is to use water that has been treated with Reverse Osmosis filtration. You can install an RO filter kit in your house for around $100 or just find a local water store as they usually filter their water through RO. Distilled bottled water also makes a great option but will be the most expensive since you'll be paying about $1 per gallon. If you do end up trying to use regular tap water make sure you let it sit in the sun for at least 24 hours to let any minerals settle and dissipate.

pH

Hydroponics is a more scientifically based method of growing plants than traditional soil based gardening and, unfortunately, its time to bring things back to high school chemistry. pH, or potential hydrogen, is the measure of the activity of the hydrogen ion and acts as an indicator of alkalinity and acidity. The reason this is important in hydroponics is that plants require a pH range of 5.5 - 6.5 in order to grow with an optimal pH of 6.0. Anything lower will result in your solution being to acidic and anything higher will be to alkaline and prevent nutrient absorption.

Pure water has a natural pH of 7.0 so you'll need to lower the pH of your water. This is easily done using a couple of drops of a pH Down solution per gallon of water (or pH Up if the pH is on the low side). RO water has a pH right at 7.0 but there is some debate over the pH of distilled water. Many say that it has the pH of natural water at 7.0 but there are others who have measured it closer to 5.5.

Either way, a pH meter is a must have so you can always make sure you measure the pH of your water yourself and measure it often.



Temperature

Simple, easy to forgot, yet very crucial is the temperature of the water you use. If you're keeping your ambient temperature in the optimal range this shouldn't be a problem but you should still check in on this every now and then especially in the cold winter months and hot summer months. Ideally you'll want to keep your water between 65°-75°F. Any colder will freeze your plant roots and any higher will cook them as well as promote algae.

Nutrients

Part of the magic that makes it all happen! Plants require specific concentrations of three main macro elements and a number of trace micro nutrients in order to grow. Normally with traditional soil based gardening plants get all the nutrients they need straight from the soil they're planted in. In hydroponics we remove the soil so its up to you to provide your plants with the nutrients they need.

On most packages of nutrients and fertilizer you'll see three letters and associated numbers: N, P, and K. The letters and numbers represent the three macro nutrients and their ratios: Nitrogen, Phosphorus, and Potassium. You'll often find a wide range of NPK values as this allows you to easily adjust the ratio of each macro nutrient based on your plants' growth stage as each stage requires a different ratio for optimal growth. For instance, during the vegetative and growth stages the "N" number will be higher while in the flowering stage the "P" will be higher. Don't be too concerned with the trace elements such as sulfur, chlorine, zinc, iron, boron, and copper as these are all included in their proper ratios as well.

Nutrient Solution

While one of the main advantages of hydroponic gardening is simplicity, picking the proper nutrients can be an overwhelming task for both experts and beginners alike. The seemingly never ending choices of nutrients, additives, boosters, fertilizers, and other assorted potions are enough to make your head spin if you start over thinking things.

The trick here is to follow a good nutrient schedule and to keep things simple as most all purpose nutrients will provide all your essential elements needed for proper growth. Try to stay away from using too many different products as this will make it extremely difficult to troubleshoot potential nutrient issues. If you're not sure where to start General Hydroponics FloraSeries is one of the most widely used and trusted nutrient mixtures on the market today. Commonly regarded as the industry standard, this is the same solution that NASA chose to use in their hydroponics research.

When mixing your nutrient solution you should always remember to check the pH of your water first to make sure its right around 6.0. Stir in your nutrients, wait about an hour for things to settle, then recheck your pH to make sure its still in the optimal range and adjust if necessary. Some nutrient solutions may come in multiple parts such as the FloraSeries. Make sure to follow the instructions on which to add first and always mix well after adding each part as incorrect steps may result in nutrient lockout. Last, but not least, finish things off by adding a couple drops of hydrogen peroxide to your nutrient solution to help inhibit bacteria and algae growth (just make sure to double check your pH).

Lighting

If you thought nutrients were confusing, indoor plant lighting takes things to a whole new level. From fluorescents to HIDs to LEDs and ballasts and timers and hoods, lighting can be quite intimidating if you let it be.

K.I.S.S

The most important thing to remember about lighting for your hydroponics garden is to keep it simple. Most people have grown common indoor plants without a second thought about lighting. Depending on what type of produce you're looking to grow with your hydroponics garden you might be able to get away with using this same type of basic approach. Simple leafy vegetables such as spinach or lettuce and most types of herbs can be grown without spending a small fortune on specialized grow lights.

That's not to say you can throw your hydroponics garden in a dark corner of a spare room and think you're going to produce results though. A bright, sunny window with access to at least 5 hours of direct, natural sunlight and another 10 hours of indirect light will be more than enough to keep your leafy vegetables nice and happy.

If you notice your seedlings growing very tall and spindly this could be a sign they're not getting enough light. The reason for growth like this is that your seedlings are stretching themselves trying to get closer to your light source. If this is the case you may need to invest in some supplemental lighting.

Grow Light Systems

While its possible to grow most leafy vegetables using nothing but lots of direct, natural sunlight supplemental plant lighting is a great way to super charge your garden and is a must to grow plump, tasty vegetables like peppers and tomatoes.

There are four main parts to go into an indoor grow light system: bulbs, ballasts, lamps, and timers. The ballast is your power source and comes in both digital and magnetic versions. Most people would recommend spending a little more on the digital version as they tend to be more efficient producing more power with less heat and run much quieter. A good simple timer isn't integral but will make your life that much simpler as you can set your lights to run for an optimum range

of 15-18 hours per day without having to worry about switching your system on or off. Your plants need to sleep just like you and I and a dark period of at least 6 hours per day plays a major part in their metabolism and growth process.

There are many packaged light systems on the market today which make things easy to get up and running straight out of the box or you can buy your parts separately to create your own custom light system. If you go this route most experts recommend buying your parts together as the individual parts are made specifically for only one type of bulb preventing you from using an HID set up for Fluorescent bulbs and vice versa.

Fluorescent Lights

Fluorescent lighting produces a cool, blue light wavelength that is ideal for seedlings, young plants, and leafy green vegetables such as lettuce and most types of herbs. The most popular fluorescent light used for hydroponic purposes is the T5 which measures 5/8^{ths} inches in diameter and usually comes in either 12" or 24" tubes. T5's are ideal for beginner hydroponic gardeners as they are the least expensive so they don't require a huge investment but more importantly don't give off much heat making them easy to work with.

While they will provide ample light for leafy vegetables they don't produce the right spectrum of light or enough lumens (light power) to support a plant's flowering/fruiting stage.

H.I.D. Lights

When you're ready to step up your plant light system or want to start growing plump, delicious tomatoes you're going to want to look at a High Intensity Discharge system. HID lights have become the standard for indoor gardening since they produce a type of light that comes very close to replicating natural sunlight but they are expensive and produce a ton of heat. There are two types of HID bulbs, each with its own strengths.

Metal Halide (MH)

MH bulbs are able to produce a light that closely mimics the power of full sunlight and is rich in the blue spectrum. This type of light is ideal for the vegetative stage of a

plant's growth and produces nice, thick, stocky plants making MH a great all-purpose, go-to light.

High Pressure Sodium (HPS)

HPS bulbs are more efficient than MH bulbs allowing them to produce more lumens per watt (more light power). This allows HPS bulbs to produce a warm light in the red/yellow light spectrum which helps promote fruit formation making them ideal for the fruiting and flowering stage of plant growth.

Conversion Bulbs and Color Corrected Bulbs

Color corrected, or blue enhanced, HPS bulbs are becoming a popular option when it comes to HID lighting. These bulbs produce a light that is more balanced in the color spectrum to help promote vegetative growth as well as fruiting/flowering.

As mentioned earlier, most plant light system parts are not interchangeable so HPS bulbs typically won't work in a MH ballast and vice versa. There is a way to get the best of both worlds though and that is to use conversion bulbs - MH bulbs that work in HPS ballasts and HPS bulbs that work in MH ballasts.

LED Lights

LEDs (light emitting diodes) have been around for many years but have only recently made their way on to the indoor gardening scene. The introduction of LEDs is a very exciting prospect since they are extremely efficient, produce very little heat, and can produce very specific color wavelengths needed to promote both vegetation and flowering.

The problem, as is usually the case when adapting new technologies, is putting the proper processes into practice. Early attempts to use LEDs in indoor growing had been unsuccessful as most LED plant lights were vastly underpowered and didn't produce nearly enough lumens to promote proper vegetation, let alone flowering. Newer, more efficient models are currently hitting the market though that look very promising.

If you want to give LEDs a try make sure your selection has at least 1W per diode (e.g. a 12 diode bulb should be at least 12W).

How Much Light

Size of Garden	HID Wattage	Lamp Height	*Cost Per 16hr Day
2′ x 2′	175 Watt	12″	$0.14
3′ x 3′	250 Watt	12″ – 18″	$0.20
5′ x 5′	400 Watt	18″ – 24″	$0.32
7′ x 7′	600 Watt	24″+	$0.48

*Calculated at $0.05 per Kwh

T5 fluorescent plant lights are much more straightforward:

Always keep 4-6" above plants

Use 40 Watts per square foot of garden space

Use 1 4' tube per 2 sq. feet of garden space

2' x 2' = 2 4' tubes

2' x 4' = 4 4' tubes

For LED plant lights you'll want to make sure your plant lights have at least 1W/bulb. For instance a 12W bulb with 12 LED lights will have 1W/bulb. Anything less than this will not give sufficient light for your plants to thrive. A 12W bulb with 12 LED lights will be enough for a 1′ x 1′ garden.

Propagation

You can either start your hydroponic garden from seeds or from store bought seedlings. While seedlings provide you with a great jump start on your garden there are more disadvantages than there are advantages. First, you introduce the possibility

of contaminating your garden with various pests, bugs, and diseases before its had a chance to start. Second, you'll need to thoroughly wash away all the dirt from the roots which may cause undue stress and damage to your plants as any dirt or foreign substances may clog your hydroponic set up. Most importantly, most stores only sell a limited variety of seedlings which will limit the choices you have for what to plant in your garden.

Hopefully your convinced to start with seeds so now you have to figure out how to get them to sprout! With a normal soil based garden you could just dig a little hole, plop them in, add a little water, and let Mother Nature take over. The process is pretty similar with hydroponics and there are actually a number of processes you can use.

Seed Starters

First thing is first - since you're not digging a hole in the dirt you'll need to determine what kind of home you'll give your seeds. There are several options here with the most popular being rockwool, or stonewool, starter cubes. These are literally rocks that are superheated, stretched, and spun - think cotton candy but in rock form. These make a great home for your seeds and plants as the material is inexpensive, easy to work with, chemically inert, won't break down, and works great at transporting water and oxygen.

Germination

The fact is that seeds want to sprout and, as long as they have the proper water, light, oxygen, and temperature, they will.

First you'll want to break off an appropriate number of cubes and soak them in *good water* for at least an hour to make sure they are properly pH balanced and to give your seeds the proper amount of water (one cube per plant per growing area). When your cubes are ready, lightly shake off any excess water and carefully place a couple of seeds in each. You'll want to place a couple in case any don't sprout and if they all do sprout you can then choose the best seedling and remove the weaker ones. If you're

growing herbs you'll want to place at least 4-6 seeds in each cube and skip the thinning process since you'll want a nice, bushy garden.

Place your prepared cubes into a mini-greenhouse consisting of a domed grow tray filled with about a half inch to inch of *good water* or a very diluted, quarter to half strength nutrient solution. You can either use a special store bought grow tray and dome or get creative and make your own with any type of container and clear lid. Nothing fancy is required here and you can even throw each of your cubes in a sealable plastic bag if you don't have a proper container. Don't worry about light at this point since seeds are used to being buried. Just make sure you keep the temperature right around a cozy 75°F and your seeds should sprout within 2-4 days or so. If you're sprouting your seeds in colder temperatures you may want to look into either using a space heater or a heating mat to make sure your seeds get enough warmth to sprout.

Once your seeds sprout top off your tray with *good water* as needed - no need to add more nutrients since its just water that's evaporating. If you started with a diluted nutrient solution just top off with *good water* rather than continuing to add more nutrients. If you started with *good water* here's where you'll want to switch over to a diluted nutrient solution - just make sure its not too strong of you'll burn your little seedlings. You'll also want to introduce your new seedlings to whatever light source you plan on using whether its a nice big sunny window or special grow lights. If you are using grow lights you'll want to make sure they're not too close to your new seedlings to keep them from getting scorched by the hot lights. Then every day or two move them just a little bit closer until the lights are the proper distance.

Your Hydroponics Garden

Continue topping off the water in your grow tray until you can see your seedlings are a couple of inches tall and the roots start to pop out from the bottom of your starter cubes. During this time you can start preparing your nutrients reservoir so everything is nice and ready when its time to transplant your seedlings to their new home.

Growing Medium

Since you're growing with zero soil you'll need something else to hold and support your plants' roots. There are three main choices you'll have to fill your net pots

including coco coir, Perlite (or silica), and LECA (Lightweight Expanded Clay Aggregate; also known as Hydroton). All three have the same basic characteristics in that they are all made of chemically inert materials. This is important for your growing medium of choice as these substances won't react with or contaminate your nutrient solution or affect your plants in any way.

Coco Coir is made from the outer brown husk of coconut shells. The substance is basically a bunch of tiny sponges that allow it to hold many times its weight in water making it a great growing medium for your hydroponics garden. Its usually sold in brick form and has to be reconstituted in water before using. While coco coir is great for aeration and water retention it does break down easily over time and is best used in conjunction with another growing medium in a 50/50 mix.

Perlite, or silica, is basically popcorn made with flakes of glass and is made by superheating specs of glass (silica instead of corn) until they expand (like popcorn). It is very light and inexpensive, holds water well yet still provides excellent drainage. These characteristics make silica a great standalone growing medium with the only drawback is that it can be a little too light and is easily washed away in some systems and is most often used in mixtures as additional filler.

LECA, more commonly know by Hydroton, is made in a similar way as perlite – think popcorn made from little clay balls. These clay balls are very light, do a good job of retaining moisture, provide great aeration, and won't wash away in your reservoir. Those traits, along with the fact that they can be cleaned and reused over and over make LECA a top choice for most hydroponic gardens. If you do choose to go with clay just make sure to thoroughly rinse before your first use to wash any loose dust from them as they come out of the bag pretty dirty.

Aeration

The final component of your hydroponics garden is going to be an air pump and air stone (with some connective rubber tubing). Proper aeration of your nutrient solution

serves two main purposes: 1) inhibit growth of mold, algae, and bacteria; 2) deliver oxygen to your plants' roots to help promote growth.

Prepping Your Reservoir

Once you've decided on what nutrients and growing medium you're going to use, have your lighting and aeration in place, and have access to *good water* its time to put it all together!

Start by mixing enough of your nutrient solution to fill your reservoir so that it reaches about 1/3 to 1/2 up from the bottom of your net pots. Remember to always use pH balanced *good water* and to follow any nutrient mixing instructions exactly. Connect your air pump and air stone using an appropriate amount of rubber tubing and place the air stone in the center of your reservoir.

Transplanting Your Seedlings

Depending on the size of your net pots and how nice you'll want to make things look - fill your net pots with enough of your growing medium so that the top of your starter cubes will be aligned with the top of your net pot. Carefully place your starter cube and seedling in the net pot and continue to fill the net pot with your growing medium to create a snug fit. Place your net pots in your slotted reservoir lid and voila - you've just completed your hydroponics garden and are on your way to growing fresh produce in the comfort of your own home!

Ongoing Maintenance

Over time the water in your nutrient solution will evaporate and you'll need to top off to bring your water level back up. Make sure to top off with *good water* only and never add more nutrient. The water loss is purely due to evaporation so your nutrient ratios will remain the same. Adding more nutrients will only increase the concentration and could lead to nutrient burn or other harmful issues.

There are different rules of thumb as to when and how often you should change your nutrient solution. Some of the more ambitious hydroponics gardeners mix a whole new solution ever week while others have great results changing their solution every 2 weeks or even once a month. If you're looking for a true hands off approach you can even use a 50% rule and only mix a new nutrient solution once you've topped off 50%

of your entire reservoir with *good water*. Experiment with different schedules and pick the one that best suits you. Just remember that your hydroponics garden is supposed to be fun – not a chore!

For more information please visit www.zerosoilgardens.com.