Outdoor hydroponic setup in Queensland, Australia filled with baby lettuce.

Introduction

Hydroponics is the science of growing plants without soil, most often in a soilless mix. In fact, many gardeners are already cultivating hydroponically. Cultivating cuttings in rockwool, peat moss, and coconut fiber is growing hydroponically. Growing mature plants in soilless Sunshine Mix or Terra-Lite, even when watered by hand, is hydroponic gardening. With hydroponics, nutrient uptake and grow medium oxygen content can be controlled easily. Manage these two factors, along with a few other requirements, to grow a bumper crop with every harvest.

The inert soilless hydroponic medium contains essentially no nutrients. All the nutrients are supplied via the nutrient solution—fertilizer diluted in water. This solution passes over or floods around roots at regular intervals, later draining off. The extra oxygen trapped in the soilless medium and around the roots speeds nutrient uptake by tiny root hairs. Plants grow fast hydroponically because they are able to take in food as fast as it can be used. In soil, as in hydroponics, the roots absorb nutrients and water. Even the best soil rarely has as much oxygen in it as a soilless hydroponic medium.

Contrary to popular belief, hydroponic gardens often require more care than soil gardens. If growing hydroponically, expect to spend more time in the garden. Extra maintenance is necessary because plants grow faster, there are more things to check, and more can go wrong. In fact, some gardeners do not like hydroponic gardening, because it requires too much additional care.

Hydroponic gardening is productive, but exacting—not as forgiving as soil gardening. Soil works as a buffer for nutrients and holds them longer than inert hydroponic growing mediums. In fact, advanced aeroponic systems do not use a soilless mix; they use nothing at all!

In hydroponics, the nutrient solution can be controlled, so plants grow less leafy foliage and more profuse flower buds. The stepped-up nutrient control makes plants flower faster and be ready for harvest a few days earlier than soil-grown plants.

Small flowering plants grow well in small hydroponic containers and horizontal tubes. Large plants grow longer and are best suited to a large bucket system, which allows room for root development. The plants' root system is easily contained in the bucket. For example mother plants used for cuttings must have a huge root system to take in lots of nutrients to keep up with the heavy growth and cutting production schedule.

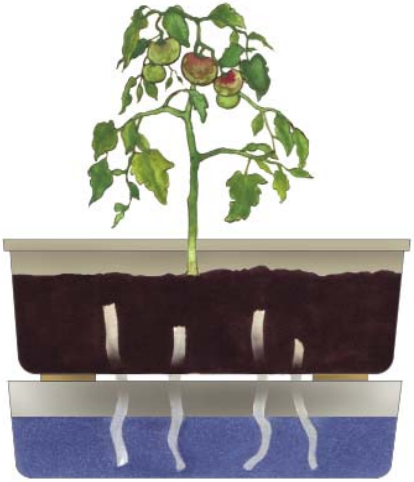
Most indoor gardens have two limiting factors: the number of plants in the garden and the electrical consumption expressed in watts. The flowering room could be illuminated with two 600-watt HP sodium lamps. A 40-watt fluorescent fixture could be used to root cuttings, and a 175-watt metal halide will keep vegetative plants growing. This is a total of 1415 watts that cost about $35 to $60 monthly. That's a bargain, considering the indoor garden's bountiful yields!

Hydroponic Systems

Hydroponic systems are distinguished by the way the nutrient solution is applied. The first distinction is whether the nutrient solution is applied in an "active" or "passive" manner.

Passive systems rely on capillary action to transfer the nutrient solution from the reservoir to the growing medium. Nutrient

solution is passively absorbed by a wick or growing medium and transported to the roots. Absorbent growing mediums such as vermiculite, sawdust, peat moss, etc., are ideal for passive systems. The growing medium can stay very wet in passive systems, and substrate selection is important. Soggy substrates hold less air and deprive roots of rapid nutrient uptake. Although passive gardens are not considered "high performance," the Dutch have managed to perfect them and achieve amazing results. Wick systems have no moving parts. Seldom does anything break or malfunction. Low initial cost and low maintenance enhance wick systems' popularity.



Classic wick gardens use cloth wicks that absorb nutrient solution and transport it to the growing medium.

Dutch gardeners line the floor of a room with heavy plastic or pond liner. They fill three-gallon (3 L) pots with an absorbent soilless mix that holds plenty of air. They flood the garden with two to three inches (6–9 cm) of nutrient solution. Roots absorb the nutrient solution in two to five days. No nutrient solution is drained off; it is all absorbed by plants!

One Spanish gardener uses passive irrigation to water his garden. He drives a delivery truck and is away from home five days a week. He keeps his indoor garden under a 400-watt HPS lamp. The plants are in a rich potting soil, and the pots are in a large tray with four-inch (12 cm) sides. Every Monday morning he fills the tray with mild nutrient solution. When he returns on Friday, the plants are strong and happy!

This cutaway of a top-feed bucket system shows how roots dangle in a 100 percent humid environment before growing into the nutrient solution. Remember to screen the drain in the reservoir so roots do not block it.

Active hydroponic systems "actively" move the nutrient solution. Examples of active systems are: flood and drain, and top feed. Fast-growing plants are very well suited to active hydroponic systems.

Active hydroponic gardens are considered a "recovery" system if the nutrient solution is recovered and reused after irrigation. A "non-recovery" system applies

the nutrient solution once, and then it runs to waste. The solution is not reused. Non-recovery systems have few complications but are not practical for most indoor hydroponic gardens. The commercial gardeners' "run-to-waste" systems are avoided, because they pollute ground water with high levels of nitrates, phosphates, and other elements. Indoor gardeners seldom use non-recovery systems, because they require disposing of so much nutrient solution into the local sewer system.

Active recovery hydroponic systems such as the flood and drain (ebb and flow), top feed, and nutrient film technique (NFT) are the most popular and productive available today. All three systems cycle reused nutrient solution into contact with roots. Recovering and reusing the nutrient solution makes management more complex, but with the proper nutrient solution, schedule, and a little experience, it is easy to manage. Active recovery systems use growing mediums that drain rapidly and hold plenty of air, including: expanded clay, pea gravel, pumice rock, crushed brick, rockwool, and coconut coir.

Ebb and Flow Gardens

Ebb and flow (flood and drain) hydroponic systems are popular because they have proven track records as low maintenance, easy-to-use gardens. Ebb and flow systems are versatile, simple by design, and very efficient. Individual plants in pots or rockwool cubes are set on a special table. The table is a growing bed that can hold one to four inches (3–10 cm) of nutrient solution. Nutrient solution is pumped into the table or growing bed. The rockwool blocks or containers are flooded from the bottom, which pushes the oxygen-poor air out. Once the nutrient solution reaches a set level, an overflow pipe drains the excess to the reservoir. When the pump is turned off and the growing medium drains, it draws new oxygen-rich air into contact with the roots. A maze of drainage gulleys in the bottom of the table direct runoff solution back to the catchment tank or reservoir. This cycle is repeated several times a day.

Nutrient solution is pumped up into the bed via the short flood fixture on the left. The overflow fitting on the right guarantees the nutrient solution will not spill over the top of the table.

Self-leveling legs, similar to those of a washing machine, support this ebb and flow garden bed and ensure all plants receive a level dose of nutrient solution and that it all drains back into the reservoir below.

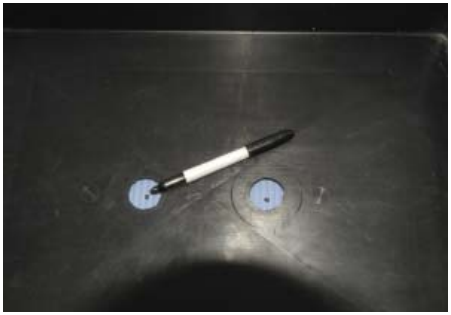
Build Your Own Ebb & Flow System

1. First, take an inventory of all the parts.

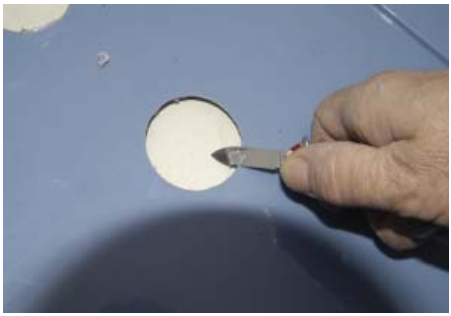
2. Different size containers fit in the ebb and flow table.

3. Nursery flat before drilling two holes near the center.

4. Use a hole drill bit to cut a hole in the bottom of the nursery flat.



5. Once holes are drilled, set nursery flat over the top of the reservoir. Mark a bull's-eye in the middle of each hole. These marks will serve as the center of the holes in the reservoir lid.



6. Make the holes in the reservoir lid big enough for the bottom of the fill/drain and overflow fittings to fit through.