Hydroponic Farming

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What are hydroponic systems and how do they work?

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Hydroponics is the art of growing crops without soil. Hydroponics is a Latin word meaning "working water." In the absence of soil, water serves to provide nutrients, hydration, and oxygen to plant life. From vegetable farming to orchids, plants thrive under the careful regimen of hydroponics. Using a minimum of space, 90% less water than conventional agriculture, and ingenious design, hydroponic gardens grow beautiful fruits and flowers in half the time.

Although the technology sounds cutting edge, the history of hydroponics dates back to the famous Hanging Gardens of Babylon, one of the Seven Wonders of the Ancient World. The Euphrates River was diverted into channels that ran down the walls of the grand garden. In the 13th century, Marco Polo wrote about seeing floating gardens in China. However, hydroponics is far from the only innovation of the ancient era. In the 1990s, NASA grew aeroponic beans in zero gravity on a space station, opening up the possibility of sustainable agriculture in space. hydroponics water conservation and vegetable remain a timeless and dynamic method of production.

What is hydroponics?

Hydroponics is the cultivation of plants without using soil. Hydroponic flowers, herbs and vegetables are planted in inert growing media and supplied with a nutrient-rich solution, oxygen and water. This system promotes faster growth, stronger yields and better quality. When a plant is grown in soil, its roots are always looking for the necessary nutrition to support the plant. If a plant's root system is directly exposed to water and nutrition, the plant does not have to exert any energy to maintain itself. The energy expended by the roots in obtaining food and water can be redirected into the maturation of the plant. As a result, leaf growth takes place as fruits and flowers bloom.

Plants sustain themselves through a process called photosynthesis. Plants capture sunlight with chlorophyll (a green pigment present in their leaves). They use the energy of light to split water molecules that they absorb through their root systems. Hydrogen molecules combine with carbon dioxide to produce carbohydrates, which are used by plants for their nutrition. Oxygen is then released into the atmosphere, an important factor in maintaining the habitability of our planet. Plants do not need soil for photosynthesis. They require soil to supply water and nutrients. When nutrients are dissolved in water they can be applied directly to a plant's root system by flooding, misting or submersion. Hydroponic innovations have proven that direct exposure to nutrient-laden water can be a more effective and versatile method of growth than traditional irrigation.

How does hydroponics work?

Hydroponic systems work by controlling environmental conditions such as temperature and pH balance, and allowing maximum exposure to nutrients and water. Hydroponics works under a very simple principle:

Provide plants with exactly what they need when they need it. Hydroponics administers nutrient solutions specifically tailored to the needs of the plant being grown. They allow you to control how much light the plants get and for how long. The pH level can be monitored and adjusted. In a highly optimized and controlled environment, plant growth is accelerated.

Controlling the plant's environment reduces many risk factors. Plants grown in gardens and fields are exposed to a variety of variables that negatively affect their health and growth. Fungus in the soil can spread disease to plants. Wildlife such as rabbits can destroy vegetables growing in your garden. Pests such as locusts can land on crops and destroy them in the afternoon. Hydroponic systems eliminate the unpredictability of growing plants outdoors and on earth. Without the mechanical resistance of the soil, seedlings can mature much faster. By eliminating pesticides, hydroponics produces healthier and higher quality fruits and vegetables. Without constraints, plants are free to grow faster and faster.

What are the components of a hydroponic system?

In order to maintain a thriving hydroponic system, you need to be familiar with some of the components that keep hydroponics running efficiently.

growing media

Hydroponic plants are often grown in inert media that support the weight of the plant. Growing media is a substitute for soil, however, it does not provide any independent nutrition to the plant. Instead, this porous medium retains moisture and nutrients from the nutrient solution that it transports to the plant. Many growing media are also pH-neutral, so they won't upset the balance of the nutrient solution. There are many different media to choose from, and the specific plant and hydroponic system will dictate which media is best suited for your endeavor. Hydroponic growing media is widely available both online and at local nurseries and gardening stores.

What are the six types of hydroponic systems?

There are hundreds of hydroponic methods, but they are all a modification or combination of the six basic hydroponic systems.

1. **Deep Water Culture System**

Deep Water Culture Hydroponics is simply plants suspended in aerated water. The Deep Water Culture System, also known as the DWC System, is one of the easiest and most popular methods of hydroponics on the market. A DWC system hangs mesh pots holding plants over a deep reservoir of oxygenated nutrient solution. The plant's roots remain immersed in the

solution, providing it with continuous access to nutrition, water, and oxygen. Deep water culture is considered by some to be the purest form of hydroponics. Since the root system is suspended in water at all times, proper water oxygenation is vital for plant survival. If there isn't enough oxygen supplied to the plant's roots, the plant will drown in the solution. Add an air stone connected to an air pump at the bottom of the reservoir to supply oxygen to the entire system. The bubbles from the air stone will also help circulate the nutrient solution. It is very easy to assemble a deep water culture system at home or in the classroom without the need for expensive hydroponics equipment. You can use a clean bucket or old aquarium to hold the slurry and place a floating surface like Styrofoam on top to hold the trap pots. In the DWC system only the roots of the plants should be immersed in the solution. No part of the stem or vegetation should be under water. You can also leave about one and a half inches of roots above the water line. Bubbles of air will escape the stone's surface and splash onto the exposed roots, so they won't be at risk of drying out.

2. **Wick System**

In a wick system, plants are placed in growing media on trays that sit on top of a reservoir. In this reservoir is a solution of water with dissolved nutrients. The wick goes from the reservoir to the growing tray. Water and nutrients flow into the wick and saturate the growing media around the plant's root system. These lights can be made from simple materials like rope or string. Wick systems are by far the simplest form of hydroponics. Wick systems are passive hydroponics – meaning they don't require mechanical parts like pumps to work. This makes it ideal for situations where electricity is either unreliable or unavailable. The Vicks System works by a process called capillary action. The wick soaks up water like a sponge, and it transfers the nutrient solution when it comes into contact with the porous growing media. Wick System Hydroponics only works when the growing media is capable of facilitating nutrient and water transfer. Coco coir (the fiber from the outer husk of the coconut) has excellent moisture retention and the added advantage of being pH neutral. Perlite is also pH neutral and extremely porous, making it ideal for a Viking system. Vermiculite is also very porous, and has a high cation-exchange capacity. This means it can store nutrients for later use. These three growing media are best suited for hydroponic wick systems.

Wick systems tend to be much slower to operate than other hydroponic systems, which limits the practicality of growing with them. You'll want to make sure you have at least one wick running from the reservoir for each plant in the grow tray. These lights should be placed close to the root system of the plant. Although capable of working with aeration, many people opt to add an air stone and air pump to the wick system's reservoir. This adds extra oxygen to the hydroponic system.

3. **Nutrient Film Technique System**

Nutrient Film Technology (NFT) systems suspend plants above a stream of a continuously flowing nutrient solution that washes over the ends of the plant's root systems. The channels that hold the plants are inclined, allowing the water to run down the length of the grow trays before draining into the reservoir below. The water in the reservoir is then circulated through

the air stone. A submersible pump then pumps the nutrient-rich water out of the reservoir and back to the top of the channel. Nutrient Film Technology is a recirculating hydroponic system.

Unlike deep water culture hydroponics, plant roots are not immersed in water in NFT systems. Instead, current (or "film") flows only over the ends of their roots. The tips of the roots will wick away moisture into the plant, while the exposed root system is provided with plenty of access to oxygen. The bottoms of the channels are grooved, so a shallow film can easily pass over the root tips. It also prevents water from pooling against or damaging the root systems.

Even though the nutrient film technology system is constantly recycling the water, it is wise to empty the reservoir and refill the nutrient solution every week or so. This ensures that your plants are being fed enough nutrition. NFT channels should be angled at a gradual slope. If it's too steep, water will run down the channel without properly nourishing the plants. If too much water is being pumped through the channel, the system will overflow and plants may drown. NFT hydroponics are popular commercial systems, as they can support multiple plants per channel and can be easily mass-produced. Nutrient film technology systems are best suited for lighter plants, such as mustard greens, kale, lettuce, spinach as well as fruits such as strawberries. Heavy fruiting plants like tomatoes and cucumbers will need trellis to support the extra weight.

4. Ebb and Flow System

Ebb and flow hydroponics work by filling a grow bed with a nutrient solution from a reservoir below. The submersible pump in the reservoir is equipped with a timer. When the timer starts, the pump fills the grow bed with water and nutrients. When the timer goes off, gravity slowly forces the water out of the grow bed and drains it back into the reservoir. The system is equipped

with an overflow tube to ensure that the flood does not exceed a certain level and does not damage the stalks and fruits of the plants. Unlike the previous systems mentioned, in an ebb and flow system the plants are not constantly exposed to water. While the grow bed is filled with water, the plants drink up the nutrient solution through their root systems. When watering is reduced and the grow bed is empty, the roots dry out. Dry roots give oxygen in the interval before the next flood. The time between watering is determined by the size of your raised bed and the size of your plants.

The ebb and flow system (also known as the flood and drain system) is one of the most popular hydroponic growing methods. Plants are supplied with an abundance of oxygen and nutrition which encourages quick and vigorous growth. The ebb and flow system is easily customizable and versatile. The raised bed can be filled with a variety of net pots and a variety of fruits and vegetables. Perhaps more than any other hydroponic system, the ebb and flow system allows you to experiment with your plants and media.

Ebb and flow systems can accommodate almost any type of vegetation. Your primary limitation is the size and depth of your grow tray. Root vegetables will require a deeper bed than lettuce or strawberries. Tomatoes, peas, beans, cucumbers, carrots and peppers are all popular ebb and flow crops. In fact, you can even attach trellises directly to grow beds. "Grow Rocks" and expanded clay pebbles (Hydroton) are the most popular growing media in ebb and flow hydroponics. They are cleanable.

5. Drip System

In a hydroponic drip system, an aerated and nutrient-rich reservoir perfuses individual plants through a network of tubes. To keep plants moist and well-nourished, this solution is slowly

dripped into the growing media surrounding the root system. Drip systems are the most popular and widespread method of hydroponics, especially among commercial growers. Drip systems can be individual plants or large scale irrigation operations.

There are two configurations of drip system hydroponics: recovery and non-recovery. In recovery systems, more popular with smaller, home growers, excess water is drained from the grow bed back into the reservoir to be recirculated during the next drip cycle. In non-recovery systems, excess water is removed from the growing media and goes to waste. This method is more popular among commercial growers. Condition

Although non-recovery drip systems may seem wasteful, large scale growers are very conservative with their water usage. These drip systems are designed to deliver just the amount of solution needed to keep the growing media moist around the plant. Non-recovery drip systems use elaborate timers and feeding schedules to keep waste to a minimum.

If you're growing plants in a recovery drip system, you'll need to adjust to fluctuating pH of the nutrient solution. This is true for any system where wastewater is recirculated into the reservoir. Plants will deplete the nutrient content of the solution as well as alter the pH balance, so the grower will need to monitor and adjust the solution reservoir more than would be required in a non-recovery system.

6. Aeroponics

Aeroponics systems suspend plants in the air and expose the naked roots to a nutrient-laden mist. Aeroponics systems are enclosed structures, such as cubes or towers, that can hold multiple plants at once. Water and nutrients are stored in a reservoir, and then pumped into a nozzle that atomizes the solution and dispenses it as a fine mist. The mist usually exits the top of the tower, allowing it to drop down the chamber. Some aeroponics mists plant roots continuously, just as NFT systems expose the roots to a nutrient film at all times. Others act

more like an ebb and flow system, spraying the roots with mist in the gaps. Aeroponics does not require substrate media to survive. The roots' constant exposure to air allows them to drink in oxygen and grow at an accelerated rate.

Aeroponics system uses less water than any other form of hydroponics. In fact, it takes 95% less water to grow a crop aeroponically than an irrigated farm. Their vertical structure is designed to take up minimal room and allows multiple towers to be placed in the same space. With the help of aeroponics, good yields can be taken even in limited places. Furthermore, due to their maximum exposure to oxygen, aeroponic plants grow faster than other hydroponically grown plants.

Aeroponics allows simple harvesting throughout the year. Vine plants and nightshades such as tomatoes, bell peppers, and eggplants all perform well in an aeroponic environment. Lettuce, baby greens, herbs, watermelon, strawberries and ginger all thrive here as well. However, fruiting trees are too large and heavy to be grown aeroponically, and plants with extensive root systems such as carrots and potatoes cannot be grown underground.