



HYDRO SCHOOL

# SCHOOL IS IN SESSION

## LESSON 1: INTRODUCTION TO HYDROPONICS

Hydroponics by definition, means ‘water-working.’ In practical use, it means growing plants in a water and nutrient solution, without soil. Hydroponics allows a gardener to grow plants in a more efficient and productive manner with less labor and time required.

The science of hydroponics proves that soil isn’t required for plant growth but the elements, minerals and nutrients that soil contains are. Soil is simply the holder of the nutrients, a place where the plant roots traditionally live and a base of support for the plant structure.

In hydroponics you provide the exact nutrients your plants need, so they can develop and grow. The nutrients are fed directly at the root base, never stressing the plant due to lack of nutrients or water.

Virtually any plant will grow hydroponically, but some will do better than others. Hydroponic growing is ideal for fruit bearing crops such as tomatoes, cucumbers and peppers, leafy crops, like lettuce and herbs and flowering plants. Most hobby hydroponic gardeners plant crops similar to what they would grow in a soil garden

Most commercial hydroponic growers combine hydroponic technology with a controlled environment to achieve the highest quality produce. Within a green-house structure you can control the ambient temperature, humidity and light levels allowing you to grow on a year-round basis.

There are many advantages of hydroponic growing. These include:

- Most hobby hydroponic gardens are less work than soil gardens because you do not have soil to till or weeds to pull.
- By eliminating the soil in a garden, you eliminate all soil borne disease  
A hydroponic garden uses a fraction of the water that a soil garden does because no water is wasted or consumed by weeds.
- In hydroponics, plant spacing can be intensive, allowing you to grow more plants in a given space than soil grown produce.

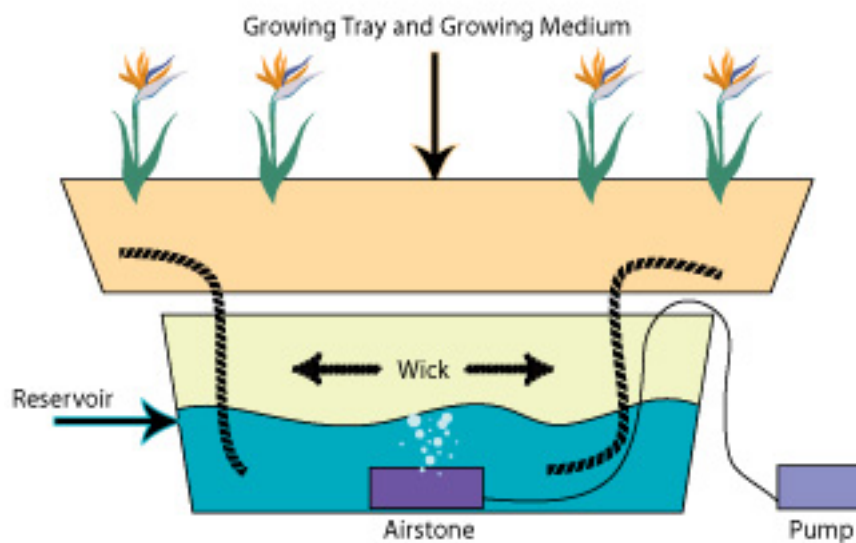
- A small hydroponic garden can be set up almost anywhere.
- By providing the exact nutrients your plants need, they will grow more rapidly and produce bigger yields.
- In studies it has been proven that hydroponic produce is higher in nutritional value than field grown crops.
- Hydroponic produce generally tastes better than field-grown produce.
- If you are growing indoors or in a greenhouse, you can grow your hydroponic plants on a year-round basis.

## SIX COMMON TYPES

In a soil garden, plants are rooted in the soil and draw nutrients from it. In hydroponics, a nutrient rich solution is fed directly to the plant roots. In some hydroponic growing systems an inert growing medium, such as rockwool is used in place of soil. These growing mediums are porous and absorb the nutrient solution, allowing the plants to use it as needed.

In other hydroponic systems, like the NFT system, no growing medium is used and the plant roots are suspended in a grow channel.

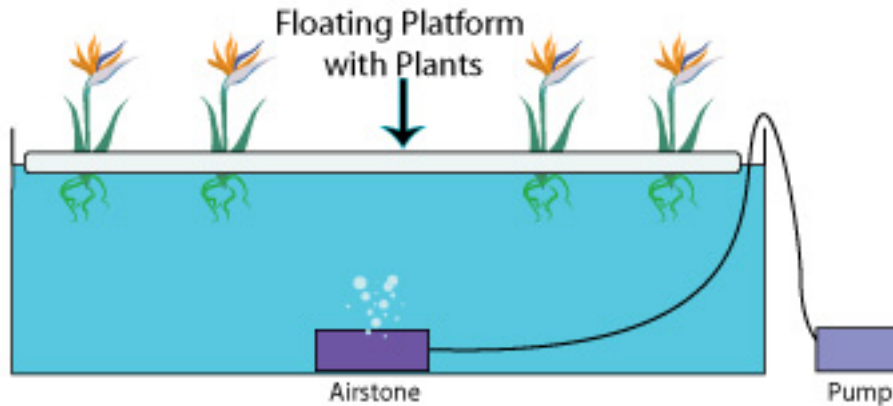
## WICK SYSTEM



The Wick system is by far the simplest type of hydroponic system. This is a passive system, which means there are no moving parts. The nutrient solution is drawn into the growing medium from the reservoir with a wick. This system can use a variety of growing medium. Perlite, Vermiculite, Pro-Mix and Coconut Fiber are among the most popular.

The biggest draw back of this system is that plants that are large or use large amounts of water may use up the nutrient solution faster than the wick(s) can supply it.

# WATER CULTURE



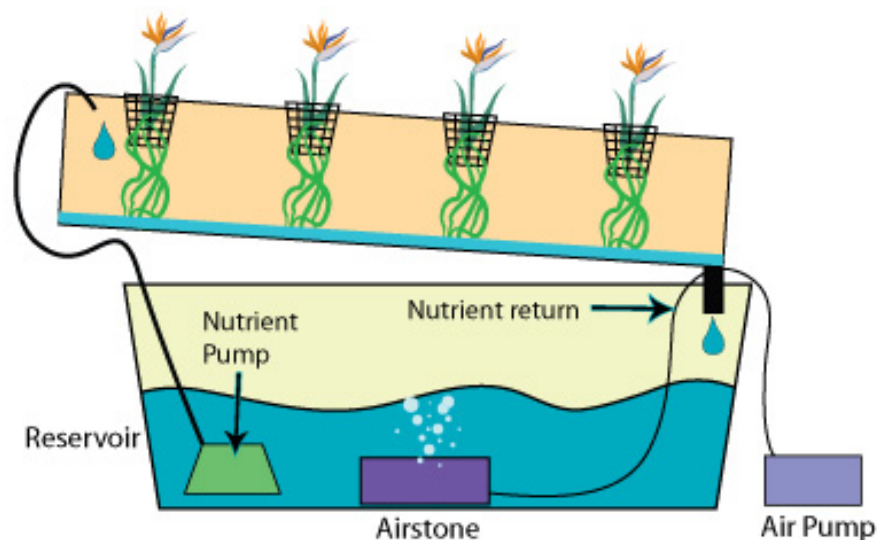
The water culture system is the simplest of all *active* hydroponic systems.

The platform that holds the plants is usually made of Styrofoam and floats directly on the nutrient solution. An air pump supplies air to the air stone that bubbles the nutrient solution and supplies oxygen to the roots of the plants.

Water culture is the system of choice for growing leaf lettuce, which are fast growing water loving plants, making them an ideal choice for this type of hydroponic system. Very few plants other than lettuce will do well in this type of system. This type of hydroponic system is great for the classroom and is popular with teachers.

A very inexpensive system can be made out of an old aquarium or other water tight container. The biggest draw back of this kind of system is that it doesn't work well with large plants or with long-term plants.

# NUTRIENT FILM TECHNIQUE SYSTEM (N.F.T)



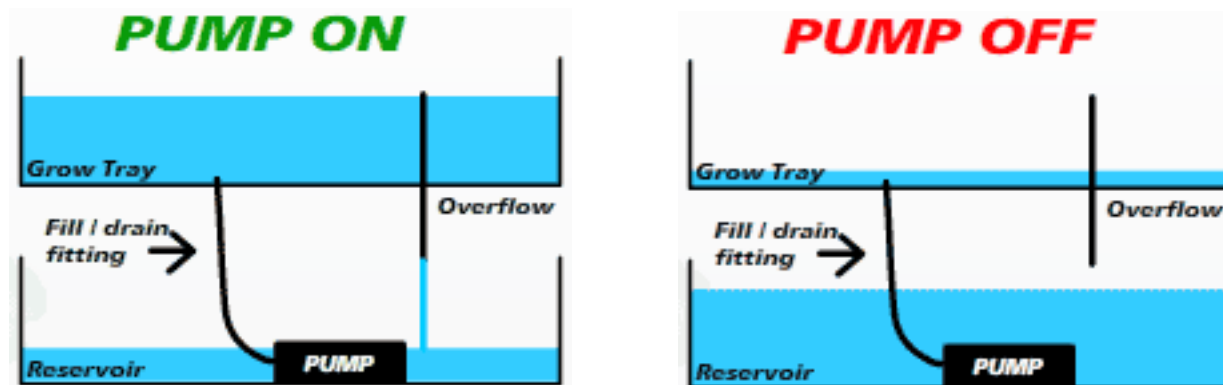
This is the kind of hydroponic system most people think of when they think about hydroponics. N.F.T. systems have a constant flow of nutrient solution so no timer required for the submersible pump.

The nutrient solution is pumped into the growing tray (usually a tube) and flows over the roots of the plants, and then drains back into the reservoir.

There is usually no growing medium used other than air, which saves the expense of replacing the growing medium after every crop. Normally the plant is supported in a small plastic basket with the roots dangling into the nutrient solution.

N.F.T. systems are very susceptible to power outages and pump failures. The roots dry out very rapidly when the flow of nutrient solution is interrupted.

## EBB & FLOW



The Ebb and Flow system works by temporarily flooding the grow tray with nutrient solution and then draining the solution back into the reservoir. It is also called the flood and drain system. Many commercial systems are of this type.

This action is normally done with a submerged pump that is connected to a timer. When the timer turns the pump on nutrient solution is pumped into the grow tray. When the timer shuts the pump off the nutrient solution flows back into the reservoir.

The Timer is set to come on several times a day, depending on the size and type of plants, temperature and humidity and the type of growing medium used.

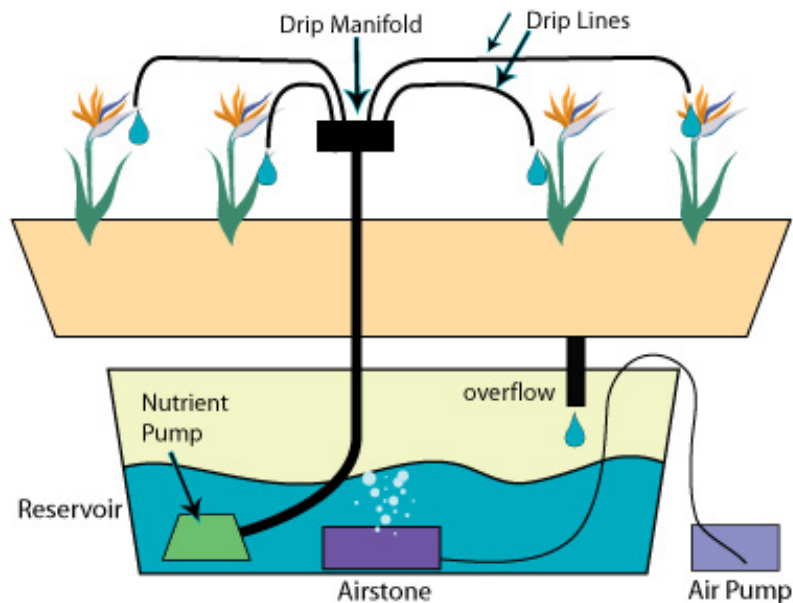
The Ebb and Flow is a versatile system that can be used with a variety of growing mediums. The entire grow tray can be filled with Grow Rocks, gravel or granular Rockwool.

Many people like to use individual pots filled with growing medium, this makes it easier to move plants around or even move them in or out of the system.

The main disadvantage of this type of system is that with some types of growing medium (Gravel, Growrocks, Perlite), there is a vulnerability to power outages as well as pump and timer failures.

The roots can dry out quickly when the watering cycles are interrupted. This problem can be relieved somewhat by using growing media that retains more water (Rockwool, Vermiculite, coconut fiber or a good soilless mix like Pro-mix or Faffard's)

# DRIP SYSTEM

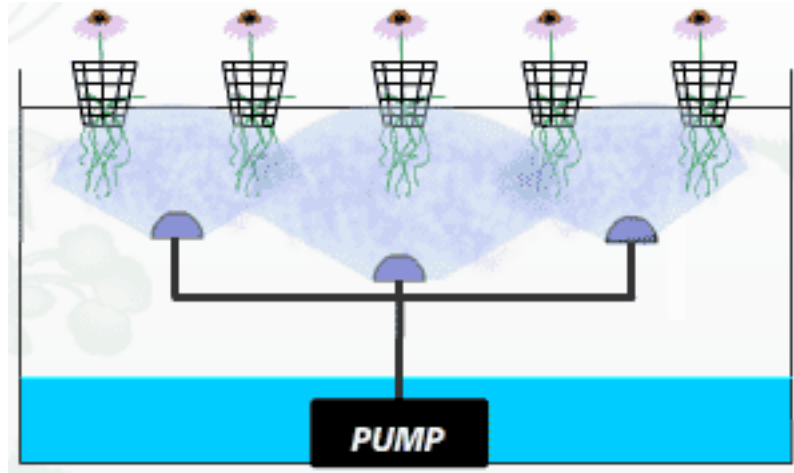


Drip systems are probably the most widely used type of hydroponic system in the world. Operation is simple, a timer controls a submersed pump. The timer turns the pump on and nutrient solution is dripped onto the base of each plant by a small drip line. In a Recovery Drip System the excess nutrient solution that runs off is collected back in the reservoir for re-use. The Non-Recovery System does not collect the run off.

A recovery system uses nutrient solution a bit more efficiently, as excess solution is reused, this also allows for the use of a more inexpensive timer because a recovery system doesn't require precise control of the watering cycles. The non-recovery system needs to have a more precise timer so that watering cycles can be adjusted to ensure that the plants get enough nutrient solution and the runoff is kept to a minimum.

The non-recovery system requires less maintenance due to the fact that the excess nutrient solution isn't recycled back into the reservoir, so the nutrient strength and pH of the reservoir will not vary. This means that you can fill the reservoir with pH adjusted nutrient solution and then forget it until you need to mix more. A recovery system can have large shifts in the pH and nutrient strength levels that require periodic checking and adjusting.

# AEROPONICS



The aeroponic system is probably the most high-tech type of hydroponic gardening. Like the N.F.T. system below the growing medium is primarily air. The roots hang in the air and are misted with nutrient solution.

The mistings are usually done every few minutes. Because the roots are exposed to the air like the N.F.T. system, the roots will dry out rapidly if the misting cycles are interrupted.

A timer controls the nutrient pump much like other types of hydroponic systems, except the aeroponic system needs a short cycle timer that runs the pump for a few seconds every couple of minutes.

## Did You Know?

Did you know that most plants are composed of about 90 percent water? It's an essential component of photosynthesis, necessary for normal cell function, and is the medium in which nutrients are transported throughout the plant. Plants need water in different amounts during different growth stages. A large cucumber plant, when fruiting, can use up to a gallon of water a day! (Transpiration uses up the majority of a plant's water intake.) In hydroponics, water with dissolved nutrients is applied as a bath, periodically irrigated through the growing medium, or sometimes sprayed directly on the roots.

In a traditional garden, plant roots are in the soil. They support the plant and search for food and water. In hydroponics, we often use a growing medium in place of soil. The roots of a hydroponic plant do not work as hard as those of a plant grown in soil because their needs are readily met by the nutrient solution we feed them.

Ideal mediums are chemically inert (no effect to PH balance), porous, clean and able to drain freely. Many materials have been used as hydroponic growing mediums. These include: vermiculite, saw dust, sand, peat moss and, more recently, rockwool, perlite and expanded clay pebbles. Today's popular growing mediums, perlite, rockwool and expanded clay pebbles are described further:

## PERLITE



Perlite is derived from volcanic rock which has been heated to extremely high temperatures. It then explodes like popcorn, resulting in the porous, white medium we use in hydroponics. Perlite can be used loose, in pots or bagged in thin plastics sleeves, referred to as “grow bags” because the plants are grown right in the bags.

Plants in perlite grow bags are usually set up on a drip feed system. Perlite grow bags usually hold 3 or 4 long-term plants.

## ROCKWOOL



Rockwool is derived from basalt rock. It too is heated to high temperatures but then is spun into fibers resembling insulation. These fibers are spun into cubes and slabs for hydroponic production.

The cubes are commonly used for plant propagation and the slabs are used similarly to the perlite grow bags. A plant is set onto the rockwool slab and grown there. The plant roots grow down into the slab. Rockwool slabs usually hold 3 or 4 long term plants.

## CLAY PELLETS



Many hobby hydroponic gardeners use expanded clay pebbles for their growing medium.

Expanded clay pebbles have a neutral pH and excellent capillary action. Often Ebb and Flow systems use expanded clay pebbles in the grow pots as the growing medium.

Now that you have some knowledge of what a hydroponics system is, it's almost time to move on to Lesson 2, But first print out the following homework sheet and fill it out if you teacher requests it, or just do the self test.