



Hydroponics

*A water-conserving
growing system*

Learning Goal

Educators will learn:

- the basic components of a hydroponics system;
- ongoing maintenance of a hydroponics system;
- and the edible plants that grow best in this system.



Why Is This Important?

- Hydroponics is a gardening system that has many advantages, notably a decrease in water usage for growing plants.
- Since hydroponics uses much less water to grow produce, it is a water-conserving growing system for both home and school gardens.



[This Photo](#) by Unknown Author is licensed under [CC BY-SA](#)

What Is Hydroponics?

- Hydroponics is the science of growing plants in a nutrient-rich solution instead of soil.
- Instead of soil, the water does the “work” of delivering nutrients to the plant’s roots.
- Because the roots are bathed in a nutrient solution, there is constant nourishment for the plants.



[This Photo](#) by Unknown Author is licensed under [CC BY](#)

What Are the Advantages of Hydroponics?

- Plants can be grown anywhere year-round.
- Provides greater control over growing conditions.
- Provides a faster growing time.
- No weeding is required.
- Uses less water than outdoor, in-soil gardening.
- Plants can be spaced close together and stacked vertically.
- Materials can be reused.

-- College of Agriculture, Biotechnology, and Natural Resources University of Nevada, Reno



What Are the Disadvantages of Hydronics?

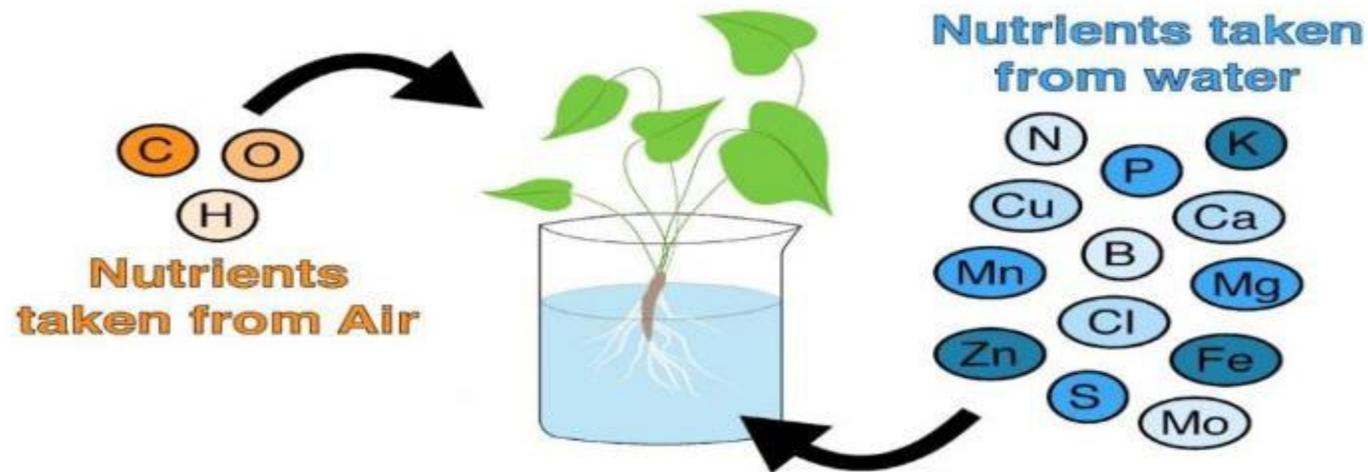
- Higher start-up costs compared to soil growing systems.
- Requires the use of electricity to power the growing system and provide sufficient lighting for plant growth if growing indoors.
- Requires some basic skills and knowledge to maintain the system.
- Diseases, when present, can spread easily.



[This Photo](#) by Unknown Author is licensed under [CC BY-SA](#)

Hydroponics Basics

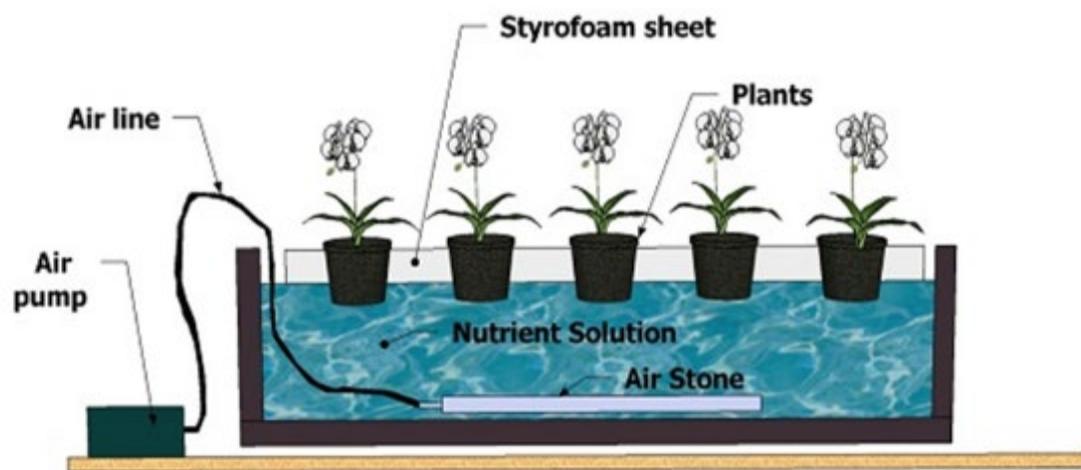
- Plants are exposed to light to allow for the process of photosynthesis, and plant roots are exposed to air allowing the roots to capture oxygen that they need to grow.
- Nutrients mixed into water feed plant growth and include nitrogen, phosphorous, potassium, and calcium.



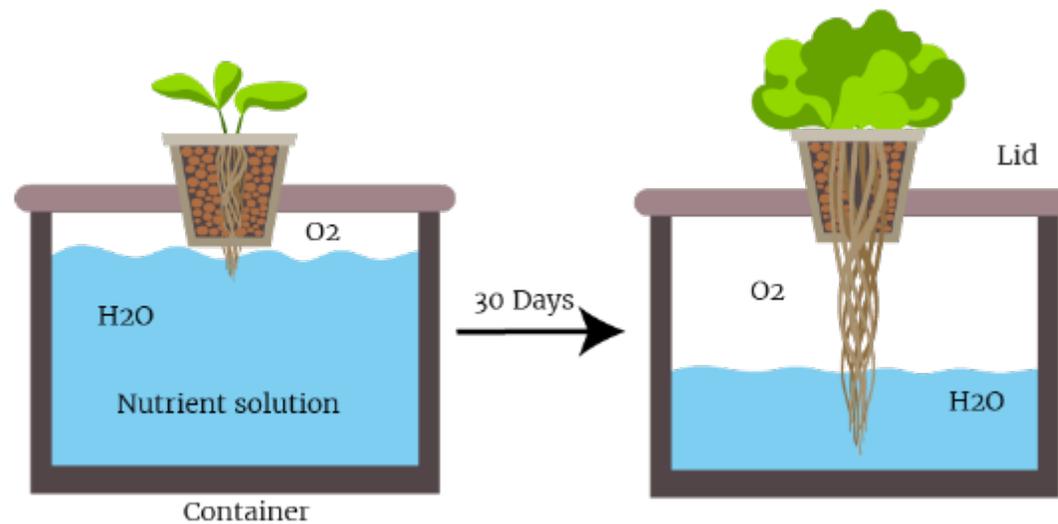
Two Categories of Hydroponics Systems

- **Dynamic** or active systems, which use pumps that oxygenate the water.

Typical Water Culture System



- **Passive** or inactive systems which do not pump water. Plants are set in a non-soil growing material and part of their roots sit in a nutrient solution.



Maintaining a Hydroponics System

Both active and passive systems require that nutrients be added to the water.

- In soil, nutrients come from rocks, minerals and organic matter. They are “held” by the soil particles and dissolved in the surrounding water before being absorbed the roots.
- In hydroponics, gardeners add nutrients to the water. The easiest way to supply these nutrients is to purchase prepared nutrients in dried or liquid form.
- Most are concentrated and must be mixed with water.

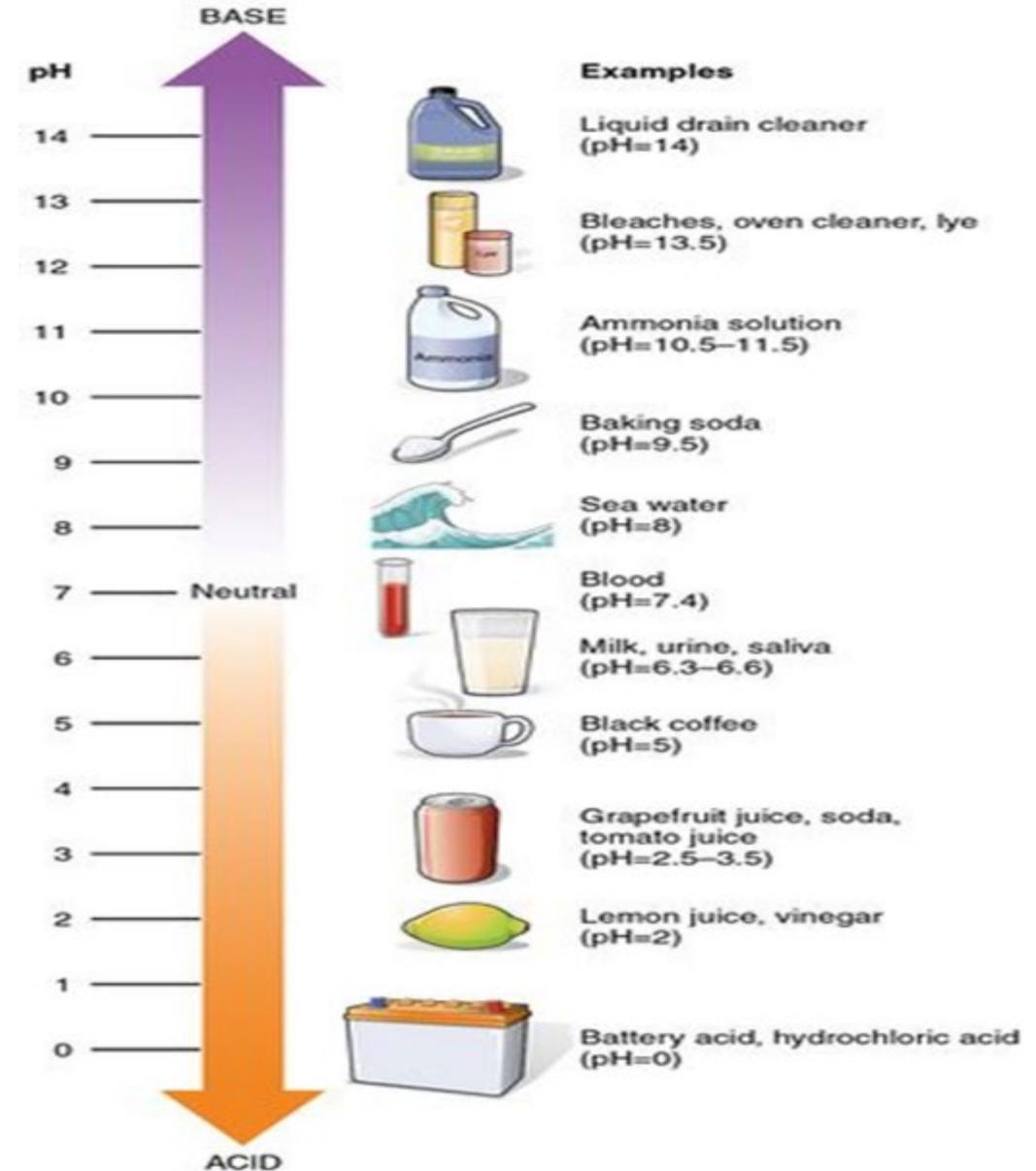


Regularly Monitor Your Nutrient - Water Solution

- Nutrient problems can result in plant symptoms very quickly. This means it is very important to use the correct combination of nutrients and regularly monitor the nutrient solution.
- Monitoring can be done by measuring the **pH** of the nutrient solution on a regular basis.

What Is pH?

- pH is a measure of the level of acidity and alkalinity on a scale from 1 to 14, with 1 being very acidic, 7 being neutral, and 14 being very alkaline, also called base.
- **Most of the plants in a hydroponics system grow best when the pH of the nutrient solution is between 5.8 and 6.5.**
- At pH readings above or below this range, certain nutrients become unavailable to plant roots.



Tools for Measuring pH

- Two of the easiest ways to obtain an accurate pH reading are to use specially designed pH test papers or a pH meter.



Replacing and Disposing of Nutrient Solutions

Nutrient solutions need to be replaced periodically. How often depends on the type of system as well as other factors. For example:

- Nutrient concentrations will vary as nutrients are taken up by the plant, and as water evaporates and transpires from plant leaves.
- As the water in your system evaporates and transpires through plants, you may top off the solution with more water to avoid building up concentrations of mineral salts.
- When replacing used water solutions, recycle this solution by watering other classroom or outdoor plants with it.



Selecting Edible Plants To Grow

Edible plants consistently recommended for growing in a hydroponic system either self-pollinate or do not need to be pollinated to produce their edible leaves.

- Kale
- Lettuce
- Spinach
- Beans (Green Beans, Pole Beans}
- Cucumber
- Peppers
- Tomatoes
- Strawberries
- White Radish
- Basil



[This Photo](#) by Unknown Author is licensed under [CC BY](#)

Increasing Your Vegetable and Fruit Production

- If your hydroponics system is indoors, bees and other insects will not be able to cross-pollinate your plants.
- You can assist with the pollination process to increase your yield of beans, cucumbers, strawberries, and tomatoes.
- Watch this brief [video](#) on how you can pollinate indoor plants.



Hand-pollination of strawberry plants

Resources

- Green Our Planet: [Why School Hydroponics?](#)
- [Hydroponics: A Brief Guide to Growing Food Without Soil](#); Treftz, C., Kratsch, H., and Omaye, S. 2015, | University of Nevada, Reno, Fact Sheet FS-15-08
- KidsGardening.Org: [Exploring Hydroponics](#)
- National Park Service: [Hydroponics: A Better Way to Grow Food](#)
- Penn State Extension: [Hydroponic Systems and Principles of Plant Nutrition](#)
- University of Florida: [Hydroponic Gardening Publications](#)
- University of Minnesota Extension: [Small Scale Hydroponics](#)
- Video: Ellen Rotheray (You Tube)
- Images: Creative Commons; harvard.edu; Stock

California Standards For the Teaching Profession

Standard 1: Engaging and Supporting All Students in Learning

- ▶ 1.3 Connecting subject matter to meaningful, real-life context

Standard 2: Creating and Maintaining Effective Environments for Student Learning

- ▶ 2.2 Creating physical or virtual learning environments that promote student learning, reflect diversity, and encourage constructive and productive interactions among students

Standard 3: Understanding and Organizing Subject Matter for Student Learning

- ▶ 3.4 Utilizing instructional strategies that are appropriate to the subject matter
- ▶ 3.5 Using and adapting resources, technologies, and standards-aligned instructional materials, including adopted materials, to make subject matter accessible to all students

Master Gardeners

The University of California Cooperative Extension (UCCE) Master Gardener Program (MGP) is an educational program designed to teach and effectively extend information to address home gardening and non-commercial horticulture needs in California.

UCCE is the outreach arm of UC's division of Agriculture and Natural Resources (ANR). Master Gardener volunteers (MG volunteers) promote the application of basic environmentally appropriate horticultural practices through UCCE-organized educational programs that transfer research-based knowledge and information.



University of California

Agriculture and Natural Resources

UCCE Master Gardener Program

Gardening Questions?

Email the UCCE Master Gardeners of Riverside County

- ▶ Email Helpline: anrmgriverside@ucanr.edu
- ▶ School Gardens: mgschoolgardens@gmail.com

Website Resources

- ▶ [Riverside Master Gardeners Website](#)



University of California

Agriculture and Natural Resources

■ UCCE Master Gardener Program