Classroom Hydroponics

Overview: Students will explore hydroponics and discover how and why plants are able to grow without soil.

Grade Level/Range: 3rd – 6th Grade

Objective: Students will learn

- to grow and thrive, plants need water, nutrients, light, air, and structural support for their roots
- hydroponic growing systems are designed so that that water is used to provide the right balance of nutrients to the plants' roots
- a non-soil material, such as rockwool, provides support for the roots

Time: 4 weeks

Materials:

- plastic container (size can vary depending on your growing space and how many plants you want to plant)
- Styrofoam sheet (1/2 to 1 inch thick and cut to fit your container)
- rockwool cubes
- easy-to-grow seeds, such as lettuce or basil
- small aquarium pump and tubing
- hydroponic nutrient solution (readily available from online retailers)

Background Information

Although hydroponic growing techniques are often viewed as being more technologically advanced than traditional growing methods, records show that plants have been grown without soil for many thousands of years. The hanging gardens of Babylon used hydroponic techniques. Marco Polo observed these systems in China. To escape enemies and compensate for a challenging growing environment, the ancient Aztecs reportedly took to the lakes and maintained large floating rafts woven of rushes and reeds on which they raised food crops.

In 1699, the British scientist John Woodward grew plants in water to which he added varying amounts of soil. He concluded that while there are substances found in soil that promote plant growth, the bulk of the soil is used for support. By the late 1800s, horticultural scientists were successfully raising plants in solutions of water and dissolved minerals. The modern science of hydroponics began in the 1930s when Dr. W. E. Gericke at the University of California raised tomatoes and other crops on floating rafts, applying the earlier principles in a commercially successful way. He coined the term hydroponics (hydro=water).

Plants, like all living things, have certain requirements that need to be met for them to grow and thrive. These include water, nutrients, light, air, and structural support for the roots. In traditional gardening, plants get root support, nutrients, water, and air from the soil. Hydroponic growers don't use soil and instead provide water and the right balance of nutrients directly to the plants' roots, enabling the plants to concentrate their energy on producing leaves and fruits rather than forming extensive root systems to search for water and nutrients. Hydroponic growers use a variety of systems to provide water and nutrients. The systems must also provide roots with the oxygen they need and offer a way for the roots to anchor the plants in place.

Read our Hydroponics How to Guide for more information about hydroponic basics and different types of hydroponic growing systems.

Laying the Groundwork:

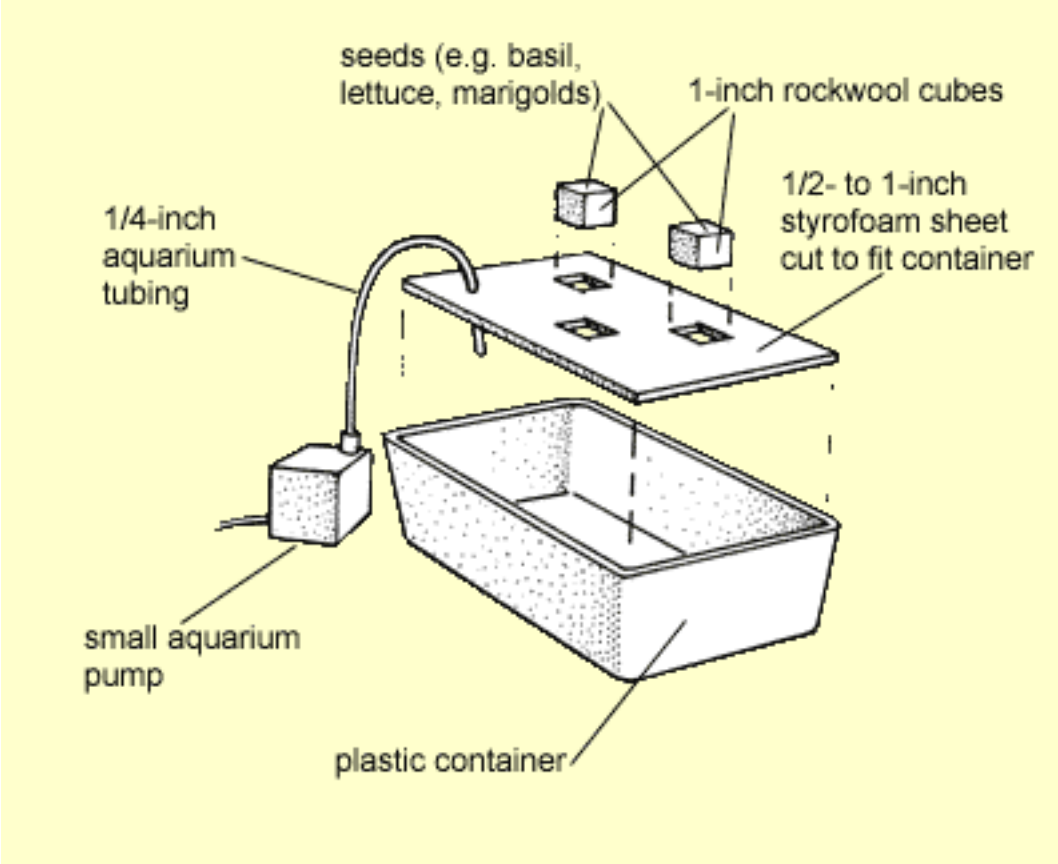
Ask students to list all the different things plants need to grow. Is soil one of those needs?

Watch the Hydroponic Gardening Video featuring lettuce grower Mary Ellen Taylor at: https://www.youtube.com/watch?v=6kUm_I7bLYw.

How is she providing for all of the plants needs? What are some of the benefits mentioned in this video related to hydroponic growing techniques?

Exploration:

Challenge your class to research, design, and create a simple hydroponic system. Here are instructions for a simple Styrofoam raft system that might serve as a springboard for other ideas:



1. Soak rockwool cubes with a dilute nutrient solution and place a seed in the top of each cube.

2. Cut a Styrofoam raft to fit in the container, then cut holes in the raft, spaced 6 to 9 inches apart, to snugly fit the rockwool cubes. Be sure the cubes extend to the bottom of the raft.

3. Poke the aquarium tubing through the raft into the solution. Keep the aquarium pump outside.

4. Fill the container with room-temperature water around to within 1 inch of the top, then float the raft with planted cubes on the surface.

5. When seedlings appear, add nutrients to the water at half the recommended strength (based on package instructions). Let the aquarium pump run continuously to oxygenate the water. After a week, raise the nutrient solution to full strength and maintain a constant level. Change the entire solution every 2 weeks.

For best growth the pH between 5.8 and 6.5. As long as you are using a nutrient solution designed for hydroponic systems and changing your solution regularly, this should not be a problem. If you are concerned, you can test your pH with pH test strips and then if needed you can raise the pH with baking soda or lower the pH with vinegar if needed.

The University of Florida offers instructions for a larger floating raft garden at:
http://edis.ifas.ufl.edu/hs184

Making Connections:

Use your hydroponic growing system to design an experiment comparing traditional and nontraditional growing techniques. Have students catalog how each system provides the chosen plant's needs and collect data and make observations to determine if one growing technique is better than the other.

Branching Out:

- Hydroponic growing systems offer solutions for planting crops in challenging environments. Use our Plants in Space Lesson to further explore the benefits of hydroponics.

- Find out if you have any hydroponic growing facilities in your area and invite a representative of the facility to be a guest speaker in your class.