Build a hydroponic system!

Name: Teacher Guide _____ Date: _____

Instructions:

1. Gather your materials to build your experiment:

    a. Container to hold water, Thick piece of square foam (e.g. Styrofoam), Plant food (e.g. MiracleGro™), Root structural support (e.g. cinder, gravel, pumice or grow stones), Aquarium aerator with tubing and airstone, Small plastic pots, Basil (1 or 2 plants with roots per group plus an extra plant that will stay in the soil), Ruler, Access to water to keep your system filled, Counter or table space with sunlight for growing the hydroponic plants, Optional: black spray paint and painters' tape, pH test kit (1 per class, available at pet stores).

2. Start with enough basil plants (ones that have roots and are already growing) for groups to create different grow condition treatments (1 or 2 plants per group)

3. Keep 1 or 2 plants in soil and place them next to, or near, your hydroponic systems (so they can grow in similar light conditions). This will be your 'control plant' and will provide a comparison to the hydroponic plants at the end of the growth period. Don't forget to water both the control and the treatment plants over the experimental period!

Prepare your water container and mixture!

4. Optional: if it is not already black, you can paint the outside of your water basin to help prevent algae growth. Using painters' tape, block of the top inch of the container and paint the bottom (so the top remains clear and you can observe the water level)

Note: You can leave the container clear! Doing so will allow you to see root growth, however a clear container may require extra cleaning to remove algae growth.

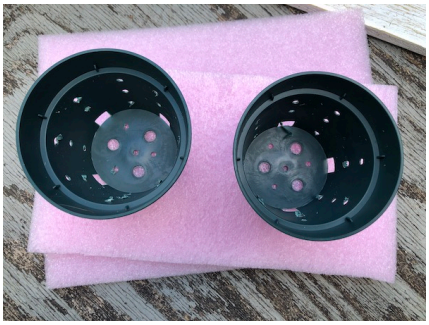
5. After the paint is dry, fill the container with water just above the black line, leaving space for displacement when you add the plants. Be sure to place your system near an outlet if you are using an aerator and airstones.

6. Stir in a teaspoon of plant food and allow it to dissolve.

Note: The amount of nutrients added might need to be adjusted based on the size of the water basin. Follow instructions on plant food packaging for assistance.

7. Plug in the aerator, and place the stones in the water mixture.

Prep your plants



8. If you are using small plastic pots that don't have holes, drill holes to allow for water transfer.

9. Trace the bottom of the hydroponic pots on the foam.
Note: Don't space the holes too far apart or the edges of the foam will sag, and your pots will not float evenly!

10. Cut out the circles in the foam. You will need to cut a little wider than the traced circle to allow the pots to sit low enough in the water.

11. Fill the bottom of the hydroponic pots with about an inch of root structural support, such as black cinder.

12. Remove the basil plants from their starting pots, gently removing soil from around the root structures.

13. Place the plants in the hydroponic pots so the bottom of the roots touch the bottom of the pots, and fill in the remaining space with more cinder so the plants can sit upright.

14. Put your hydroponic pots into the holes of the foam. Allow about an inch or two of the pots to be exposed below the foam—this lower two inches of the pot will be submerged in the water.

15. Place your hydroponic pot and foam combination in your water container and allow them to grow!

Care for your system

16. Water will evaporate over time, so you will need to refill your container. Every time (or every other time!) that you refill, add more nutrients to keep the plants growing well.

17. Optional: Use your pH test kit to check the pH regularly. This will help ensure your system is stable. Basil likes a pH of about 6.5-6.8, so you can adjust as needed using your pH up or down bottles in the test kit.

18. Let the plants grow!

19. Measure your plants' growth, and record your results in the data table on your worksheet. Use a consistent method to measure, for example:

    a. Place the bottom of the ruler at the base of the plant and measure to the tip of the main stem.

    b. Count the number of leaves, or choose a leaf to measure each time.

20. Compare these results to the plant grown in soil only.

Look for students to make thoughtful observations and measurements.

Hydroponic and soil plant growth data sheet

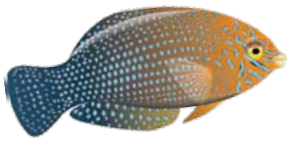
Name: Teacher Guide

Type of Plant: Results will vary by type of plant, quality of soil, and amount of light and water, etc.

Date	Soil Plant Height	Hydroponic Plant Height	Notes and Observations
May 1	6 cm	6 cm	Both plants started off the same height with very amounts of root matter and similar amounts of leaves.
May 6	9 cm	8.5 cm	Both plants are growing, but the one in the soil is growing taller. The one in the hydroponics is growing a lot of roots though, and it seems to be making leaves.
May 11	11 cm	10 cm	The soil plant continues to grow taller, and the hydroponics plant continues to grow in a bushier style —more outward and less upward.
May 16	12.5 cm	11.5 cm	The plants grew the same amount in height this time, but they continue to have different growing patterns, with the hydroponics one more leafy.
May 21	14 cm	12.5 cm	Both plants seem to be doing well in their environments. The soil one continues to be taller.
May 26	16 cm	14 cm	The end of our trial shows that the soil plant reached the highest height, but the hydroponics one has more leaves and a bushier look.

Answers will vary. We have provided suggested responses based on our trials.

Activity Questions



1. What happened to your best growing plant during the experiment?

   It was hard to tell which plant was the best growing because the soil plant grew taller but the hydroponics plant made more leaves. The soil plant grew upwards more and had a thicker, sturdier feel to it.

2. Where did your plant get its energy to grow?

   From the sun. Note: the plant did not get energy from the water or from the nutrients, rocks, or soil.

3. What resources did you give your plants?

   I gave my plant sunlight, water, nutrients, and a home (plastic container and rocks to physically support it).
   I gave my soil plant soil and water.

4. Compare the basil grown in soil versus the one grown hydroponically: Look for students to describe the overall plant shape and health.

   a. Describe how your hydroponic plant grew.

      The hydroponic plant grew well, but it grew less in height and less in stem thickness than the plan in soil. However, the hydroponic plant grew more on the sides. It grew more new stems and leaves.

   b. Describe how your plant in soil grew.

      The plant in soil grew taller than the plan in water. The soil plant also appeared to have a thicker stem and be sturdier than the plant in water. But, the soil plant did not grow side branches like the water plant.

5. Collect the class data for plant growth:

   a. What was the class average hydroponic plant growth height (cm)?

      The average hydroponic plant grew 8.5 inches (ours grew 8 inches)

   b. What was the class average soil plant growth (cm)?

      The average soil plant grew 11.25 inches. (ours grew 10 inches)

6. How does your data compare to the class average?

   The class data was similar to our results, we were just a little bit slower in growing than the average.

7. Did the plants need soil to grow? What evidence do you have?

   No, because my plants in water also grew. And, the plants growing in water with nutrients added grew even faster in some ways (like the side stems and leaves) than the soil plants.

8. Why do you think plants normally grow in soil?

   Soil is all around us and has the things that plants need to grow, like nutrients, water and structural support.

9. What do you think soil provides to plants?

   Soil helps to hold water and provide structure for plants. Soil also contains microbes, like bacteria, and other small organisms like bugs and earth worms, that help aerate the soil (provide access to oxygen) and convert waste from dying plants and animals into nutrients that are useful to plants.

10. How are hydroponic plants surviving without soil?

    We are providing nutrients and structure. Hydroponically growing plants takes more human effort, but hydroponics also helps to grow plants quickly in a pest-free zone, which is good for lettuce and tomatoes.

11. Aquaponics is a system that combines aquaculture (the growing of aquatic animals, like fish, snails, clams, etc.) in combination with hydroponicly grown plants. In aquaponic systems, growers do not need to add nutrients (like you did in this hydroponic experiment). Explain why aquaponics systems do not need added nutrients.

    The nutrients in aquaponics systems comes from the animal waste (pee and poop), which is recycled by microbes (like bacteria) and converted into nutrients that the plants can use to grow.