

Hydroponics to Aquaponics!

Name: _____

Date: _____

Instructions:

1. Gather your supplies to build your hydroponic system:

- Tank for water (or other clear, large container)
- Plastic basket for plant (should have holes so water can circulate the roots of the plant)
- Wooden dowel (x2 that are long enough to span more than width of the tank)
- Substrate for inside the tank (e.g. Sand (washed), Fish tank rocks)
- Root structural support (e.g. cinder, gravel, wood fibers, perlite, vermiculite, pumice or grow stones)
- Larger rocks for tank adornment
- Small plant for hydroponic growth (herbs like basil grow easily and quickly)
- Small plant in larger pot for growth in soil (herbs like basil grow easily and quickly)
- Aerator and airstones
- Nutrients (e.g. nutrient additive such as MiracleGro. Tomato plant food will do the trick).
- Optional (but very helpful!): Magnetic glass cleaner to remove algae
- Optional: pH test kit
- Ruler

2. Eventually, you will need the following supplies to convert it into an aquaponic system

- Guppies, snails, and/or shrimp
- Aquatic plant
- Optional (but very helpful): filter (can be purchased online or at local pet shop)



Build your hydroponic system

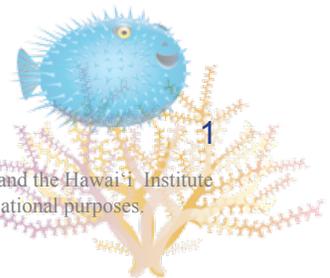
3. You will compare plants grown hydroponically to those grown in soil.

NOTE Hydroponics is the method of growing plants in water (without soil). In comparison, Aquaponics is a system that combines aquaculture (the growing of aquatic animals, like fish, snails, clams, etc.) in combination with hydroponically grown plants.

4. To prepare, replant one of your small plants into a larger pot so that it has space to continue to grow in soil.

5. You will be measuring your plants' growth and recording your results in the data table on your worksheet. Choose a consistent method to measure, for example:

- Place the bottom of the ruler at the base of the plant and measure to the tip of the main stem.
- Count the number of leaves, or choose a leaf to measure each time.



Prepare your tank

6. Rinse the tank substrate with warm water a few times to prepare it for your ecosystem. Make sure the tank is clean as well!
7. Find a location for your tank with direct access to sunlight and near an outlet (to plug in the aerator).
8. Layer about an inch or two of the substrate on the bottom of the tank.
9. Fill the tank with water. The water may look cloudy at first while the substrate settles.
10. Place the airstone on the bottom of the tank and plug in the aerator. You can bury it slightly under the substrate.
11. Add nutrients according to the instructions on the packaging and based on the size of your tank.
12. Place your plant growing in soil (from #2) next to the tank so it has access to sunlight. Allow it to grow here for the remainder of the study.
13. Measure the starting height of your soil plant and record it on your worksheet.

Explore hydroponic growth!

14. Now that your hydroponic system is set up, maintain the system and observe plant growth!
 - a. 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.
15. 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.

Note: If you are making your own nutrient solution rather than using plant food, review [Perfecting the pH of your Hydroponic Nutrient Solution](#).
16. Continue monitoring and measuring your plant growth for your desired amount of time. When you are ready to convert your system into aquaponics, move on to the steps below!
17. Compare these results to the plant grown in soil only.



Update your Hydroponics to Aquaponics

1. Before you begin, answer these questions:
 - a. How do scientists study plants and animals in their natural habitats?
 - b. What might be some limitations, challenges, or risks with studies in the natural environment?
 - c. What is the ethical treatment of living things? How will you ensure your animals are being treated ethically?
 - d. Why do animals, including humans, eat things?
 - e. Do plants eat?
 - f. What is a: producer? Consumer? Decomposer?



2. Allow your hydroponics system to cycle out excess nutrients before adding fish - i.e. give the water some time since you last added nutrients. You may also want to change out 1/3 of the water a few days before adding organisms.
3. Review the recommendations for managing care of living organisms (teacher recommendations document).
4. Collect organisms from a local stream if you have permission and safe, easy access.
5. Organisms may include guppies, snails, shrimp, and freshwater plants such as elodea and duckweed, etc.
Note: If you don't have access or permission to a local stream, organisms can be purchased from a pet shop.
6. Add a few large rocks to the bottom of the tank. These will provide unique structure to the bottom that the fish can swim around.
7. Add the aquatic plants to your tank. Tuck the roots into the substrate. You may need to add a large rock nearby to hold the roots down.
8. Gently add the fish and other organisms to the tank.

Care for your ecosystem!

NOTE Your system should be able to maintain itself through the cycling of matter between producers, consumers and decomposers. However, since this system is small and might not represent every trophic level, you will still need to feed the fish to ensure they are getting enough energy.

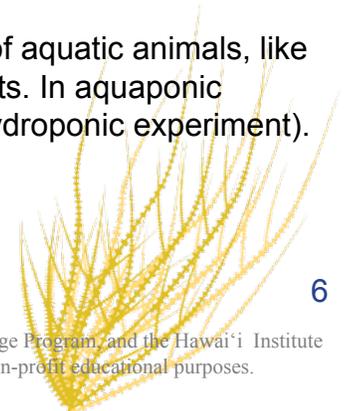
1. FEEDING: Drop a few flakes or pellets (depending on food choice) on the surface of the water to feed the fish few days (every 2 or 3 days should be fine).
2. CLEANING: You will need to replace about 1/3 of the water every 1-2 weeks as needed. This will prevent algae buildup and ensure enough oxygen is available (The plants will contribute to the oxygen available).
 - a. Prepare replacement water the day before, allowing it to sit out over night to evaporate any chlorine.
 - b. Remove the top (plant or cap) and scoop out about 1/3 of the water using a cup (a turkey baster can also provide easy access to removing water). Be careful not to scoop any fish with the water!
 - c. If there is algae build up on the exposed walls, you can wipe it off with a paper towel or clean sponge to prevent overgrowth. Pour in fresh water slowly so as not to stir up any loose particles. Alternatively, if you have a magnetic tank cleaner, use that to wipe the walls regularly to clear the algae.
3. Optional: Monitor pH:
 - a. If you keep up with changing the water the pH should stay relatively stable, however biological activity within the tank can cause the pH to fluctuate. Use your pH test kit to check the pH.
4. Additionally, a filter will help maintain the pH. Although the plant roots are doing some filtration, a filter may help to keep your system stable.



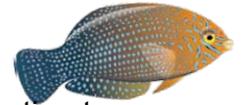
Hydroponics Activity Questions



1. What happened to your best growing plant during the experiment?
2. Where did your plant get its energy to grow?
3. What resources did you give your plants?
4. Compare the basil grown in soil versus the one grown hydroponically:
 - a. How much did your hydroponic plant grow?
 - b. How much did the plant in soil grow?
5. Collect the class data for plant growth:
 - a. What was the class average hydroponic plant growth height (inches)?
 - b. What was the class average soil plant growth (inches)?
6. How does your data compare to the class average?
7. Did the plants need soil to grow? What evidence do you have?
8. Why do you think plants normally grow in soil?
9. What do you think soil provides to plants?
10. How are hydroponic plants surviving without soil?
11. Aquaponics is a system that combines aquaculture (the growing of aquatic animals, like fish, snails, clams, etc.) in combination with hydroponically 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.



Aquaponics Activity Questions



1. Match the vocabulary words with their definitions below. Then use the information to answer the activity questions.

Vocab Word	Answer	Definition
Matter		A. An organism requiring food, which it gets by eating other organisms.
Consumer		B. An organism, often bacteria, fungus, or invertebrate, that breaks down waste from other organisms.
Decomposer		C. Organisms that use energy from the sun and matter in air and water to grow.
Primary Producer		D. Any substance that has mass and takes up space by having volume.

2. What role does your plant play in making food from matter your ecosystem-in-a-bottle?

3. What role does your fish/snail play in moving matter your ecosystem?

4. What role does the bacteria living on the rocks play in recycling matter in your ecosystem?

5. Which organism in your ecosystem is a:

a. Primary producer?

b. Consumer?

c. Decomposer?

6. How do the organisms in your ecosystem work together to recycle matter and produce food?



7. Draw your own food web based on your ecosystem in a bottle (there are many correct food webs!). Label the primary producer, consumer, and decomposer.

8. What might happen if a higher level predator was introduced to your ecosystem (such as a crayfish, large fish, or large frog)?

9. Is there evidence of any other plant life in the aquarium? (Hint: It is possible that microscopic freshwater algae may have grown, and if it becomes dense enough may appear either as a greenish film, or perhaps a greenish hue in the water.)

10. How are models beneficial to scientists when studying plants and animals?

11. How could you improve your design for a future aquaponics system?

