Name _____ Class _____ Date _____

Exploration Lab

RESEARCH

Designing a Hydroponic Garden

Agricultural land on Earth is decreasing rapidly as the human population puts increased pressures on land. The need to feed an ever-increasing human population has also led to farming practices that promote soil erosion, intensify desertification, and reduce soil fertility. Researchers are investigating new ideas for efficient ways to feed the global population with an increasingly limited growing environment. One way to expand our food resources is to use soil-free farming, or hydroponics. In hydroponics, plants are suspended in a soil-free medium and fed a special solution containing all the nutrients necessary for growth. In this activity, you will have the opportunity to research, design, and build your own hydroponic garden.

OBJECTIVES

Design, build, and **grow** a hydroponic garden.

Observe and describe plant growth in the hydroponic garden.

Evaluate the problems encountered and offer solutions for correcting those problems.

MATERIALS

- aquarium air pump (to provide air for plant roots)
- books and other reference materials on hydroponic gardening
- non-soil growing media (such as vermiculite, perlite, peat moss, or sodium polyacrylate)
- hydroponic nutrient solution or general purpose fertilizer
- mask for breathing protection
- pH indicator paper or solution (such as bromthymol blue)
- pH adjusting solutions (such as pH Plus or pH Minus)
- plant seeds or young seedlings (12)
- plastic plant containers, 8 cm dia. (12)
- plastic plant tray
- self-supporting light fixture

Procedure

PART I—DESIGN PROPOSAL

1. Research methods for hydroponic gardening at the library or on the Internet. You may use books, articles, or Web sites. Have your teacher assist you in determining the reliability of Web sites. Record any interesting facts or insights that you uncovered about the history or future of this method of agriculture.

Designing a Hydroponic Garden *continued*

2. There are many different kinds of hydroponic growing systems. The four basic methods are drip irrigation, flood and drain, capillary system, and deep-water culture. Each method has its variations.
- Drip irrigation—A nutrient solution drips into each plant container. Dripping may be timed or continuous.
- Flood and drain (ebb and flow)—The nutrient solution floods the roots of the plants at timed intervals.
- Capillary system—Plants are continuously fed a nutrient solution from a basin through a wick or porous growing medium.
- Deep-water culture—Plant roots are immersed in nutrient solution and exposed to the air through bubbling action.

3. Which hydroponic method will you select to use in your project? Explain why you chose this particular method.

4. Select the types of plants you would like to grow. Record your decision and the reasons for your choice below. Have your teacher approve your choices.

5. What kind of artificial light will you provide for your garden? Different types of artificial lighting are commonly selected for specific plant varieties. Record your selection and reasons for your choice.

6. Decide on a nutrient solution for your plants. In traditional gardening, plants obtain most of their nutrition from the soil. In hydroponics, all of the nutrients a plant needs must be in the water. You can mix your own nutrient solution; however, it often is less expensive and time-consuming to purchase a ready-made nutrient mix. Explain what nutrient solution you decide to use and the reasons for your choice.

7. Choose a growing medium and record your reasoning for the choice below. In traditional gardening, soil supports the plant and its root system. Growing plants in a container filled with water is the simplest and least expensive form of hydroponic culture. However, many plants require more support. A growing medium needs to be clean and lightweight, and must allow air to reach the roots.

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8. Design your hydroponic garden and draw a detailed sketch of your design in your notebook. Be sure to include lighting, planting media, temperature regulation, types of plants, and your feeding system. Make sure your design is affordable and practical. Write and submit your design proposal. Get your teacher's approval. Include notes on how many hours the lights will be on, and how many hours they will be turned off.

PART II—BUILDING THE GARDEN

9. Build your hydroponics system and make sure it is ready for plants or seeds. Before preparing the nutrient solution, be sure the water is pH neutral and does not contain chlorine. Test the water with indicator solution or paper and adjust the pH. Allow tap water to stand uncovered overnight to let the chlorine escape.

10. Make drainage holes in the containers. Fill them with the planting medium you selected. Sow your seeds at the correct depth or raise seedlings and then transfer them to the growing medium once they have permanent leaves. Plant the entire garden at the same time.

11. Prepare a logbook to monitor the growth of your garden. Have your teacher review your data collection plans. Measure the growth of plants every three days. Examine the plants for signs of disease or nutritional deficiencies. Consult gardening books to identify problems and solutions. Describe the general health and appearance of the plants. Make sketches of the plants.

SAMPLE PLANT LOG SHEET

Log Entry #8 March 3

The average height of the plants was 15 cm today. Eight of 12 plants show signs of yellowing at the edges of leaves. Several plants are wilting. Perhaps the plants are not being watered enough. My gardening book suggests yellowing may indicate a nitrogen deficiency. I have increased the concentration of nitrogen in the nutrient solution and adjusted the timer to water the plants every hour instead of every two hours.

Analysis

1. **Describing Events** Summarize the difficulties and problems you encountered in constructing or maintaining the soil-free growing environment. How did you solve or attempt to solve these problems?

2. **Analyzing Data** What are some of the advantages of soil-free hydroponic gardening?

Conclusions

3. **Applying Conclusions** Under what conditions might a soil-free system be best for crop production?

4. **Evaluating Methods** How could your hydroponics system be modified for large-scale production?

Extension

1. **Designing Experiments** Based on what you have learned, make a prediction about one of the requirements of your hydroponics system, such as the lighting or nutrient solution. With your teacher's input, design an experiment to test your prediction. Change the variable you have identified and compare the plants grown under the new conditions. Report your results to the class.