Hydroponics

Background

Look in your refrigerator at the amount of food needed for just one week. Consider that when humans go to Mars the trip will take more than a year. Packing a year's supply of food could easily tax the spacecraft's available space and weight requirements It would be practical for the crew to grow their own food along the way. One form of farming that is being considered for long duration missions is hydroponics, the science of growing plants in a solution of water and nutrients instead of soil. Growing plants in water has two main advantages. One is the availability of water, as water is a by product of a spacecraft's fuel cells. Secondly plants grown in a hydroponic manner can be grown closer together, requiring less room then plants grown in soil beds.

Although hydroponics offers many advantages for long duration missions, other methods of growing plants are being tested. Growing plants in gel packs is one new method that is currently being researched. Particular crops are being tested to determine how much oxygen they give off, and how much food they can provide. Wheat has been established as a main crop choice for future space travel.

Topic

Hydroponic Gardening

Objectives

Students will:

- Investigate the necessary conditions to grow food for a long duration mission.
- Design and construct a controlled environment to grow plants without the use of soil.

Overview

Providing food for long duration missions is a major concern of many scientists. The safe growth of food is imperative. In this activity students will grow plants without soil in a nutrient rich solution.

Key Question

Why are scientists experimenting with hydroponics to grow plants for long duration missions?

Key Concepts

- Hydroponics is the science of growing plants using a solution of water and nutrients instead of soil.
- Because of the amount of space, weight limitations, and time involved in long duration missions, alternatives will have to be developed for growing food crops.

Materials & Preparation

- Gallon milk containers (2 per garden)
- Gravel (enough to fill each garden)
- 1 plastic hose per garden (1 meter long)
- Epoxy glue
- Commercial nutrient solution mix (enough to make about 1 gallon per garden)
- Lettuce seeds
- Hydroponic growing cubes (available in most gardening stores, 4 per garden)
- Plant light with timer
- Scissors

1. Cut the top off of two 1 gallon milk containers.
2. Connect the two containers using one piece of hose. To do this, put a hole in the side of the containers, about an inch above the bottom.
2. Insert one end of the hose into each hole and seal the edges with epoxy glue.
4. Label one container "Garden" and the other "Nutrient Solution."
5. Fill the container labeled " Garden" 3/4 full with gravel.
6. Place one seed in each growing cube and place them in the container labeled "Garden." Space the cubes evenly throughout the container and make sure they are nestled securely in the gravel.

7. Fill the nutrient solution container 3/4 of the way with nutrient solution.
8. Place the gardens under the light and set the light timer for 16 hours every day so that the plants receive a consistent amount of light every day.
9. Feed the plants twice a day once in the morning and once in the evening. To do this, raise the solution container above the garden so that the nutrient solution flows into the garden. Let the solution remain in the garden for fifteen minutes and then lower the solution container below the garden so that the solution drains out of the garden.
10. Have students keep a two week journal. Students should observe their plants daily, recording changes in root development, measuring and recording plant size, describing the overall condition of the plant, recording any changes in growing conditions (if the light goes out or a student forgets to feed the plant, this should be recorded) Students should also include a daily drawing of the plant.
11. At the end of the two weeks have students answer the reflection and discussion questions as their final journal entry.

Management

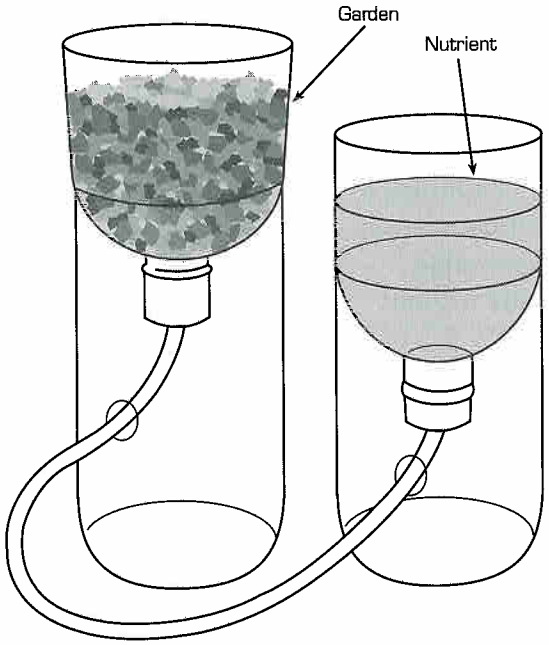
Students will observe all safety procedures and policies including, but not limited to, personal safety and safe handling of materials. This activity will take one to two classes to assemble. Students will then make observations for two weeks. To simplify this activity, hydroponics kits can be ordered from a science catalog.

Reflection & Discussion

1. Did all plants grow at the same rate by the end of the observation period? Why or why not?
2. Why do you think lettuce seeds were chosen for this experiment?
3. Other than providing food, what important elements do plants provide for a long duration mission?

Transfer/Extensions

1. Challenge: Design and construct a hydroponic garden containing all the necessary vegetables you think are needed for the journey to Mars.
2. Calculate how much food you would need according to your age and weight. This information can be obtained by looking at a nutrition chart.
3. What foods have you chosen to take and why?



STUDENT WORKSHEET

Hydroponics

Materials to make your own hydroponic garden

- 2 large clear plastic tubs or 2 liter soda bottles
- gravel (enough to fill one container)
- 1 meter of plastic hose
- epoxy glue
- 2 liter soda bottles
- 1 gallon of nutrient solution
- lettuce seeds
- hydroponic growing cubes
- Scissors

Student Procedures

1. Cut the top off of two soda bottles.
2. Connect the two containers using one piece of hose. To do this, put a hole in the side of the containers, about an inch above the bottom.
3. Insert one end of the hose into each hole and seal the edges with epoxy glue.
4. Label one container "Garden" and the other "Nutrient Solution."
5. Fill the container labeled "Garden" 3/4 full with gravel.
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