



How Does My Garden Grow?

Level

Grades 5 and higher

Introduction

Plants on earth use energy from light to combine water, carbon dioxide from the air, and nutrients from the soil to produce roots, shoots, leaves, flowers and seeds. No animal on earth, or in space, can accomplish this feat. Instead, all animals, from earthworms to humans, must depend, directly or indirectly, on energy stored by plants to live and grow.

In this activity, groups of 3-4 students each (there should be at least 4-5 groups) will (a) prepare and plant seeds for test plants, (b) care for and observe plant growth in their Space Gardens, and (c) collect data and evaluate the test plant's suitability for cultivation in space.

How Does My Garden Grow? provides students with the opportunity to learn about basic plant growth and development and plant culture techniques while growing their plants in the Space Garden. They will also learn units of measure and gain experience measuring, weighing and estimating.

Question

What are some plants that astronauts can grow for food in space?

Hypothesis

Plant "X" meets the objective and subjective criteria for being successfully grown in space.

Design

Students will grow plants, measure plants and evaluate them against established criteria. They will communicate their data using tables, graphs, photo and narrative presentation.

Timeframe

A maximum period of 30-60 days will be required, depending upon the length of the growing periods for the specific plants chosen by the students. The time for each class period will vary according to the observations or measurements being made. A few minutes will be required on Mondays, Wednesdays and Fridays throughout the course of the activity for observation, measurement and maintenance of the Space Garden.

Learning Objectives

In participating in this activity students will:

- Learn about plant cultivation by caring for plants in their Space Gardens
- Learn about plant growth by observing the emergence and growth of seedlings
- Learn that different types of plants have different growth requirements and different growth patterns
- Gain experience in measuring, weighing and determining/estimating area and volume
- Learn to evaluate results by comparison with established criteria
- Use tables, graphs or other media to present data
- Gain communication skills by discussing initial options, articulating the reasons for plant choice and presenting in oral and/or written form the results and conclusions regarding the suitability of the chosen plant for space gardening

Materials

Space Garden kits - 1 for each 4 students plus 2 kits for control plants

Marking tape & pen

Metric Ruler

Scale accurate to 1 mg

Seeds for test plants

Light source (fluorescent lamps are recommended)

Procedure

1. Students meet in small groups to discuss possible criteria for choosing seeds to plant (teacher should have available a variety of seeds or a seed catalog to choose from).
2. Students meet as a group to choose 5-6 the possible criteria that will be used by all groups for final evaluation (extra: in the end, would different plants be judged suitable or not suitable if the criteria had been chosen differently?).
3. Students select or order seeds.
4. Students prepare and plant Space Garden (if seeds are available, steps 1-3 can be done in one 50-minute class period). Plant seeds according to package directions. This is Day 1. Place all units under a light source. Fluorescent tube lights in an ordinary fixture work well. Plants should be placed under the same light source. The tops of all Space Garden units (with the bellows completely closed) should be approximately 1 cm from the light source.
5. By DAP¹ 3-6 the seedlings will have emerged depending upon plant type; record the actual DAP on which the plant begins to emerge. Sketch the emerging plantlet. Does it have one or two cotyledons? Note differences and similarities between the plant types at this stage of growth. As the plants grow, extra plants should be removed (“thinned”) so that one healthy plant is left in each planting location.
6. Water plants every other day. To water the plants, add enough water to saturate the Arcillite, then withdraw and discard 60 ml of water (it may not be possible to draw out a full 60 ml of water each time). This method ensures that all units will be hydrated correctly and uniformly. The process of flushing and removing water also helps to aerate the rooting medium.
7. Use data sheets to record (in ml) amount of water used each time. The amount of water required for the plants to grow could be a consideration in suitability for space gardening.
8. Expand the Space Garden bellows as necessary to provide growing room for the plants. Keep the tops of each unit equidistant from the light source. Light baffles may be constructed using aluminum foil to help distribute light evenly around the plants.

9. At 7-day intervals, measure and record plant height and number of leaves, and determine leaf length and width for any leaf large enough to measure. Estimate area of plant material (area of a rectangle = length x width, area of an oval = length x width x 0.8). Note some similarities and differences among the different plant types. Do the plant types look more or less similar to each other as they mature than they did at the seedling stage? In what ways?
10. At maturity date (as noted on seed packet), harvest plants. Record the area and weight of the leaves. If the leaves are not the edible portion, (e.g., radishes) measure and weigh the edible portion. Estimate/calculate the volume of the edible portion. Discuss the difference between calculating (accurate and precise, but difficult for uneven shapes) and estimating (easier because it's based on idealized shapes, but less accurate and precise). What proportion of the total plant mass is the edible portion? Was a specific edible volume or weight one of the initial selection criteria?
11. Each group of students should evaluate its plant choice against the chosen criteria and prepare a statement of why or why not the test plant would be suitable for space gardening.
12. Graphs and tables can be used to present statistical information. Photos documenting plant growth would enhance interest and presentation. Which test plants are suitable for space gardening and which are not? Why? Ranking? They may also want to discuss whether or not they would now choose/rank the criteria differently.

Concluding activities and further questions

- How many of the original seedlings germinated? What is the germination rate?
- Did all of the germinated plants survive? What is the survival rate?
- Were any plants deliberately removed? Why?
- Did the plant mature in the expected time?

¹ Days after planting

How Does My Garden Grow? Data Collection Sheet

Group # _____ Type of Plant: _____ Date planted: _____
 Name: _____ Number of seeds planted: _____ Date first plant emerged: _____
 _____ Initial water added: _____ ml Distance of Space Garden top from light: _____ cm
 _____ Type of rooting medium: _____ Nutrients added? _____
 _____ Expected days to maturity: _____ Actual days to harvest: _____

Date	Days After Planting	Water added	Plant Height	Leaf Number	Leaf Area	Comments

