



# NASA Food Technology Commercial Space Center

## Educating Youth Through Horticulture

### Environmental Factors that Affect Plant Growth Lessons

by Cynthia Haynes

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**BACKGROUND** Greenhouses are designed to optimize plant growth and production. These structures accomplish this task by manipulating or maximizing natural resources or aspects of our environment.

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**LESSON SUMMARY** Students will compare

1. The production of plants
2. Teaching strategies in two different settings

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**STUDENT LEARNING OUTCOMES**

- Recognize and describe different environmental factors that affect plant growth while touring production and research greenhouses
- Design a plant production facility for space
- Observe teaching and learning strategies
- Prepare a lesson for youth
- Work cooperatively in small groups
- Present/discuss lessons with class
- Analyze and revise lessons throughout the semester

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**MATERIALS**

- Functioning Greenhouse
- Maps of the Greenhouse area
- Discovery Bag (examples of different materials used in plant production)
- Blackboard/White Board and writing utensils
- Clip boards with paper and pencils
- Space Plant Production Facility Worksheet
- Examples of plant products for space travel
- Video or other examples describing space travel
- Sample lessons for youth
- [Resource worksheet on space conditions/limitations](#)

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**INSTRUCTIONS GIVEN TO STUDENTS** *Small Groups – Assigning Tasks and Brainstorming*  
Students will form small groups (3-4 students in each group). Elect or assign roles to each member (recorder, timekeeper, chair, consultant). In small groups discuss and list 3 environmental factors that affect the growth of plants. (Recorder writes down list.) Allow only **5-7 minutes** for this portion.

*Class – Accountability and Sorting*

Each group relates one environmental factor that affects plant growth, no repeats. Facilitator writes these on the board. Repeat. Facilitator asks: What do you know about these factors? Which are most important and why?

Allow **10-15 minutes** for this portion.

As a class, go to the head house of the greenhouse. Discuss greenhouse protocol. (Facilitator asks: Before we begin, what are some greenhouse rules?)

In small groups, go into the greenhouse and look for ways these factors or others are used/manipulated to promote/inhibit growth of plants. Hand out maps of the greenhouse area. Timekeeper is responsible for timely return of group. Recorder takes notes on materials used in plant production and relation to environmental factors. Chair and/or consultant navigate group through the greenhouse range. Allow **15 minutes** for this activity, then meet back in the head house.

End on: What questions do you have?

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**NOTES FOR  
FACILITATORS**

Facilitator leads class through certain greenhouse and has each group point out aspects of greenhouse plant management. Facilitator asks questions like: **(20-30 minutes)**

- What is that used for?
- How is this place heated?
- How are the plants watered?
- What about bugs?
- What is in the soil?
- Do all greenhouses look like this one?
- What else could greenhouses have to optimize plant growth?
- What would you change to optimize plant growth?
- End on: What questions do you have?

Go back to class and write this statement (assumption) on the board: *Plants can grow anywhere as long as certain environmental factors are met.*

What if we had to grow plants in space on the mission to Mars? Would the environmental factors plants need to grow change in space?

What would change? (Hand out sheet on space conditions/limitations)

Facilitator asks each same groups to design/create a greenhouse or growing structures for the space station/shuttle on a trip to Mars. List the important criteria to be considered. How would the environmental factors be met? How would you modify the different materials you saw in the greenhouse

for a space plant production facility? What problems would you encounter? Allow **15-20 minutes** for groups to discuss and work on a rough sketch. (Same roles in each group.)

Facilitator allows each group to discuss their answers and show their sketch. Other groups and facilitator ask questions.

Facilitator stresses why growing plants in space is important. Show a portion of the video on space food or farming in space. Show examples of space food. Show letters to Iowa (DSM Register) about space food. Discuss how NASA is tackling this problem. Allow **10-15 minutes** for the video, food samples, and brief discussion.

**Conclude:** Facilitator asks questions: (**10-15 minutes**)

- Are plants only important for food production in space?
- What would you change on the design of your space plant production facility?

What did you learn about plant growth? About teaching?

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## COMMUNICATION AND LEARNING STRATEGIES

**Transparent Teaching:** (Pass out lesson plan)

An important part of this class is **not only** to teach you aspects of plant growth, but also to make teaching more transparent. This was a sample lesson. The teacher was a facilitator in learning. A facilitator plays an important role in teaching and has many responsibilities.

The facilitator probed for prior knowledge at the beginning of the lesson. Therefore, the facilitator could adjust the lesson based on what you already knew.

You worked in groups or teams and were elected to roles within that group. The facilitator held the group accountable for answers to questions and assignments.

You were also allowed some hands-on experience while touring. This also allowed you the opportunity to explore and ask your own questions. The facilitator answered those questions (hopefully!).

The facilitator introduced new material to educate by stimulating thought and discussion, not to overwhelm you with information.

The facilitator also organized an opportunity for you to reflect on your learning so that you may apply this knowledge in the future.

**Homework:**

Your Turn! Use what you know and what you can research to teach elementary students how to grow plants in space. In your small group work to develop a lesson plan with a hands-on component for next class.

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**Instructor:**

Cynthia L. Haynes  
Department of Horticulture  
Iowa State University  
chaynes@iastate.edu

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**LEGEND:**

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—COMMUNICATION MATERIALS

—PROJECT LEARN MATERIALS

—INSTRUCTOR MATERIALS