Learning Guide

Space Gardens

We hope you enjoyed learning all about gardening in space. Extend your learning with this print-ready Learning Guide!

What's in this Learning Guide?

Get Set to Listen
Answer TRUE or FALSE statements before and after listening to the episode.

Vocabulary

Discussion Questions
CCSS.ELA-Literacy.SL.3-8.1, SL.3-8.3

Writing Prompts
CCSS.ELA-Literacy.W.3-8.1, W.3-8.2, W.3-8.3, W.3-8.4, W.3-8.7, W.3-8.8

Space Gardening vs. Earth Gardening: Venn Diagram Activity
CCSS.ELA-Literacy.RI.5.5; CCSS.ELA-Literacy.W.3-8.1; NGSS: 5-LS1-1

Design a Space Garden
NGSS: 3-5-ETS1-2, 5-LS1-1, MS-ETS1-2, MS-LS1-5; CCSS.ELA-LITERACY.RI.3–8.2, SL.3–8.2

Build a Microgravity Water System
NGSS: MS-LS2-1, 3-5-ETS1-2, 3-5-ETS1-3, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4; CCSS.ELA-Literacy.SL.3–8.2, SL.3–8.1

Space Farmer Experiment: Experiment Plan, Plant Science Data Collection Worksheet, Data Analysis Worksheet, & NASA Space Farm Research Report Template
NGSS: 3-5-ETS1-3, 3-LS3-2, 5-LS1-1, MS-LS1-5, MS-LS1-6, MS-ETS1-3, MS-ETS1-4; CCSS.ELA-Literacy.SL.3–8.2, RST.6–8.3, RST.6–8.7, WHST.6–8.2

Additional Resources & Book List

The Children's Hour
kids public radio

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https://www.childrenshour.org/space-gardens/

Get Set to Listen

1. Before listening!

Read each statement and write TRUE or FALSE based on what you already know.

2. After listening!

Based on what the experts said in the episode, write TRUE or FALSE.

Before Listening	TRUE or FALSE?	After Listening
	1. Astronauts traditionally prepared all their meals by cooking them in an oven in space.	
	2. Plants in space need light, water, and warm temperatures, just like plants on Earth.	
	3. Plants grow in space the same way they grow on Earth because gravity is not important.	
	4. Astronauts may need to pollinate flowers themselves because there are no bees in space.	
	5. Chili peppers were selected partly because their flowers contain everything needed for pollination in one flower.	
	6. NASA does not use ordinary dirt in its space plant experiments because it may contain harmful microbes.	
	7. Growing food in space could help astronauts on future missions to the Moon and Mars.	

What did you learn?

_____

_____

_____

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Get Set to Listen

Answer key

1. FALSE. Space stations do not use ordinary ovens. Open flames can be dangerous in a microgravity environment, so astronauts rely on specially prepared meals.
2. TRUE
3. FALSE. Gravity makes a big difference. Without gravity, water floats around instead of naturally flowing downward, so special growing systems are needed.
4. TRUE
5. TRUE. Pepper flowers contain both male and female reproductive parts, making pollination easier than with some other vegetables.
6. TRUE. Scientists use specially prepared growing materials, such as clay particles, and add nutrients that plants need.
7. TRUE

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Listen

Use these Shorts clips in the classroom or anytime you want to learn more about a specific topic we talked about in the **full-length Children's Hour Space Gardening episode**!

- Part 1: How and Why to Grow Plants in Space
  - (segment 8:30-12:41)
- Part 2: The Moon Chile Challenge
  - (segment 23:50-29:36)
- Part 3: The Evolution of Food in Space
  - (segment 33:09-38:29)
- Part 4: The Challenges of Growing Plants in Space
  - (segment 43:16-48:42)

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Vocabulary

Listening for Words

1. Make a four-column chart and label the columns “I don’t know,” “I’ve seen or heard, but don’t know the meaning,” “I think I know the meaning,” and “I know the meaning.”
2. Write the vocabulary word in the column that describes how well you know the meaning of the word.
3. Listen to **the episode**. Note how the speaker uses the words.

Matching Words with Definitions

1. Print and cut apart the word and definition cards.
2. Spread out the word cards so you can see them all. One by one, attach a definition card to each word card.

Writing with New Words

After working with the words and definitions, write a one-page essay or story that uses at least three of the words.

agriculture	The practice of growing plants and raising food.
root system	The part of a plant that absorbs water and nutrients.

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Vocabulary

nutrients	Substances plants need to grow healthy and strong.
microgravity	A condition in space where objects seem to float.
hypothesis	An educated guess or prediction about what you think will happen in an experiment. It can be tested through an investigation.
variable	Something in an experiment that can be changed, measured, or kept the same.

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Discussion Questions

1. Have you ever planted a seed or grown something to eat? What did you learn?
2. How is growing food in space similar to growing food in your backyard or garden?
3. What could you learn from growing the same plant in different locations or conditions?
4. Why is growing fresh food in space important for astronauts?
5. What do you think would be the hardest part of growing a garden without gravity?
6. Imagine you are an astronaut traveling to Mars. Would you rather eat packaged space food or fresh vegetables you grew yourself? Why?
7. Why is it important for scientists to invite students and communities to participate in research?
8. If you could only bring three kinds of plants to grow on the Moon, which would you choose? Explain your choices.
9. What would you miss most about food on Earth if you lived in space?

Group Discussion Strategies

Think Pair Share:
1. Individually, student writes down their answer to a question.
2. Students pair up and tell each other their answers.
3. Teacher calls for volunteers to share with the whole class their answer (and/or their partner's answer). Teacher notes key words/phrases on board.

Round Robin:
1. Teacher poses one question (written on top of a large page) to students, who are assembled into small groups of 3 or 4.
2. Students take turns brainstorming the answers. The recorder of the group writes down all answers.
3. The leader reads the group's ideas to the entire class. Teacher moderates.

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Writing Prompts

Narrative Prompts

1. You have just arrived at a Moon base, and your job is to build the first garden. Describe what your garden looks like, how you take care of it, and what happens when something unexpected goes wrong. *(What if the water floats away? What if the plants don't grow? What would you do?)*
2. It is the year 2050. You are a scientist living on Mars. Write a letter to a student on Earth describing what life is like, what foods you grow, and why having a garden is important.
3. You are watering your plants in a space greenhouse when suddenly the water starts floating everywhere! Tell a funny or exciting story about how you and your crew solve the problem before all the plants are ruined.

Informational/Expository Prompts

1. Explain how astronauts grow vegetables aboard the International Space Station. Include information about light, water, temperature, growing containers, and the challenges of growing plants without gravity.
2. Describe how space food has changed over time. Explain the difference between early food tubes, freeze-dried meals, food pouches, tortillas, and fresh vegetables grown in space.
3. Explain what plants need to survive and grow. Why can't we simply plant seeds in the Moon's dirt? What would scientists need to provide inside a Moon greenhouse?
4. Create a guidebook for the first astronauts who will grow food on Mars. Include at least five important instructions and explain why each one matters.

Opinion/Persuasive Prompts

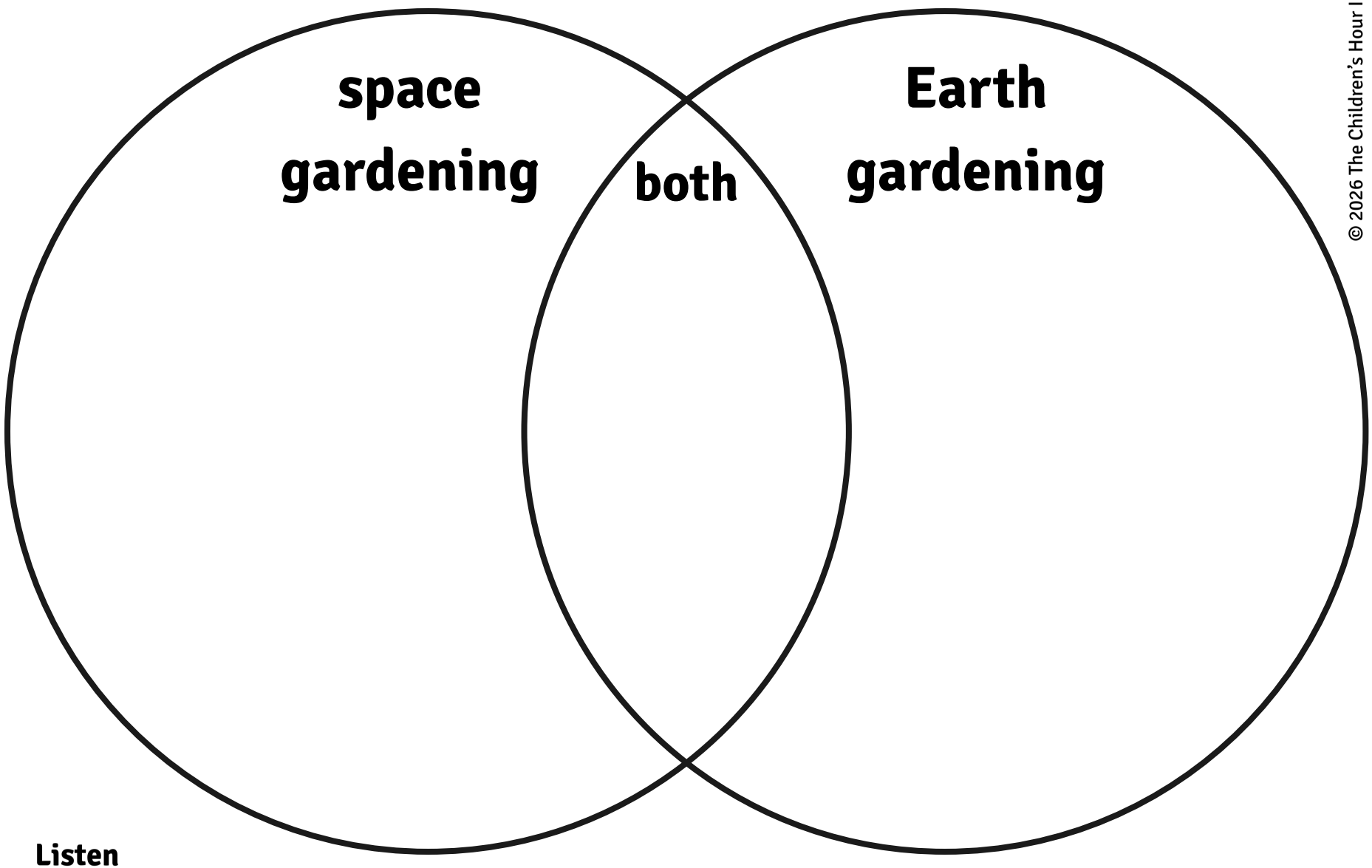
1. Should astronauts grow chili peppers, lettuce, tomatoes, strawberries, or something else? Choose one food and convince NASA scientists that it deserves a place in the space garden.
2. Should schools spend more time teaching students how to grow food?
3. Do you think humans should build permanent homes on the Moon or Mars? Consider food, water, safety, technology, and the benefits of exploring space.

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Space Gardening vs. Earth Gardening

Name_____

Compare growing food on Earth with growing food in space.



Listen

- Part 1: How and Why to Grow Plants in Space (segment 8:30-12:41)
- Part 4: The Challenges of Growing Plants in Space (segment 43:16-48:42)

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Design a Space Garden

Listen

- Part 1: How and Why to Grow Plants in Space (segment 8:30-12:41)
- Part 4: The Challenges of Growing Plants in Space (segment 43:16-48:42)

Watch this video to help you select plants to grow in space.

Your Mission

You are a scientist helping astronauts grow fresh food on the Moon or Mars! Design a greenhouse that provides a safe place for plants to grow, even in the challenging conditions of outer space.

Plan

What foods do you plan to grow?	What do they need to thrive? *(temperature, water amount, nutrients/soil type, amount of light, growing space, pollination requirements)*

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Design a Space Garden

Plan

- How will water reach the plant roots without floating away? *(See **"Build a Microgravity Water System"** activity in this Learning Guide.)* _____

_____

_____

_____

- How will plants get the light they need to grow? _____

_____

_____

_____

_____

- How are your plants pollinated? _____

_____

_____

_____

- What will provide the nutrients plants need to grow well? _____

_____

_____

- How do you prevent contamination? _____

_____

_____

_____

- How will the greenhouse protect plants from extreme temperatures, radiation, and the harsh environment outside? _____

_____

_____

_____

_____

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Design a Space Garden

Diagram

Use the plan you made on the preview page to draw and label a greenhouse inside a habitat on the Moon or Mars. After completing your drawing, write a short explanation describing how your greenhouse works and how each feature helps plants grow.

Remember: *There is no single right design. Be creative, use what you learned about growing plants in space, and imagine how your greenhouse could help astronauts grow fresh food on the Moon or Mars!*

Model

Use a variety of materials (such as cardboard boxes, aluminum foil, LED lights, straws, and reused plastic containers) to construct a model of your space greenhouse.

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Build a Microgravity Water System

Listen

- Part 4: The Challenges of Growing Plants in Space (segment 43:16-48:42)

The Problem

Water behaves differently in space than it does on Earth. Without gravity, water can float away instead of flowing down into the soil and reaching plant roots. Astronauts need a way to deliver water to plants without wasting it or making a mess.

Your Mission

You are a space scientist! Design and build a model irrigation system that delivers water directly to plant roots without spilling or leaking. Your goal is to create a system that could help astronauts grow fresh food inside a Moon or Mars habitat.

Possible Materials

- Plastic cups
- Straws
- Sponges
- Plastic tubing
- Water
- Small containers

Brainstorm

- *How would you keep water from floating away in space?* _____

_____

_____

_____

_____

_____

_____

- *How can you deliver water directly to plant roots?* _____

_____

_____

_____

_____

_____

_____

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Build a Microgravity Water System

Plan

Draw a design for your irrigation system. Think about how water will travel from its container to the plant's roots.

Build

Use the available materials to create a model irrigation system.

Test

Add water to your system and observe how well it delivers water to the target area.

Improve

Look for leaks, spills, or places where water gets stuck. Which materials work best? Make changes to improve your design.

Evaluate

Test your improved system again. Did it deliver water more efficiently?

Reflect

- *Why is conserving water important for astronauts living on the Moon or Mars?*

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Space Farmer Experiment

*Join the **Moon Chile Challenge** to participate in real space gardening research!*

Listen

- Part 2: The Moon Chile Challenge (segment 23:50-29:36)

Your Mission

Can you grow a healthy plant without using regular outdoor soil? Become a plant scientist and space farmer to find out! Investigate what plants need to grow, experiment with different growing conditions, collect scientific data, and decide which conditions produce the healthiest plant.

Materials

- Choose a seed
  - bean, pea, lettuce, radish, or pepper
- Choose a growing material
  - cotton balls, paper towels, clay pebbles, regular potting soil (for comparison)
- Growing containers
- Water and light

Discuss

- *Do plants need regular soil to grow?*
- *What materials could astronauts use instead of soil?*
- *Why are water and light important?*
- *How could scientists grow food on the Moon or Mars?*

Use the following worksheets to plan, conduct, record and analyze your results.

- **“Space Farmer Experiment Plan”**
- **“Plant Science Data Collection Worksheet”**
- **“Data Analysis” worksheet**
- **“NASA Space Farm Research Report”**

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Space Farmer Experiment

Space Farmer Experiment Plan

Choose ***one*** condition to investigate:

- More light vs. less light
- More water vs. less water
- Cotton balls vs. paper towels vs. clay pebbles
- Type of seed

My scientific question: _____

_____

_____

My prediction (hypothesis):

I predict that _____

_____

because _____

_____

The *one* condition (variable) I will change: _____

_____

What I will keep the same: _____

_____

_____

Remember: *Change only one variable at a time. Keep other conditions consistent so you can make fair comparisons. Use the same observation schedule.*

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Space Farmer Experiment

Plant Science Data Collection Worksheet

Conduct Your Experiment

Observe your plant every few days for 2–3 weeks. Measure its height, count its leaves, observe its color, and record the growing conditions.

Scientist's Name: _____

Plant Type: _____

Growing Material: _____

Variable Changed: _____

Date Planted: _____

Data Table 1: Measuring Plant Growth

Measurement	Day 1	Day 5	Day 10	Day 15	Day 20
Plant height (cm)					
Number of leaves					
Leaf color					
Soil/material moisture					

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Space Farmer Experiment

Plant Science Data Collection Worksheet

Observation prompts

- *Did the seed begin to sprout?*
- *Did the stem get taller?*
- *Did new leaves appear?*
- *Did the leaves change color?*
- *Did the plant look healthy or unhealthy?*
- *Did the growing material stay wet or dry out?*

Data Table 2: Watering and Observations

Day/Date	Did I water it?	Amount of water	What changes did I notice?

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Space Farmer Experiment

Data Analysis

1. How much did your plant grow from Day 1 to Day 20? _____

2. When did your plant grow the most? _____

3. How did the number of leaves change? _____

_____

4. What color were the healthiest leaves? _____

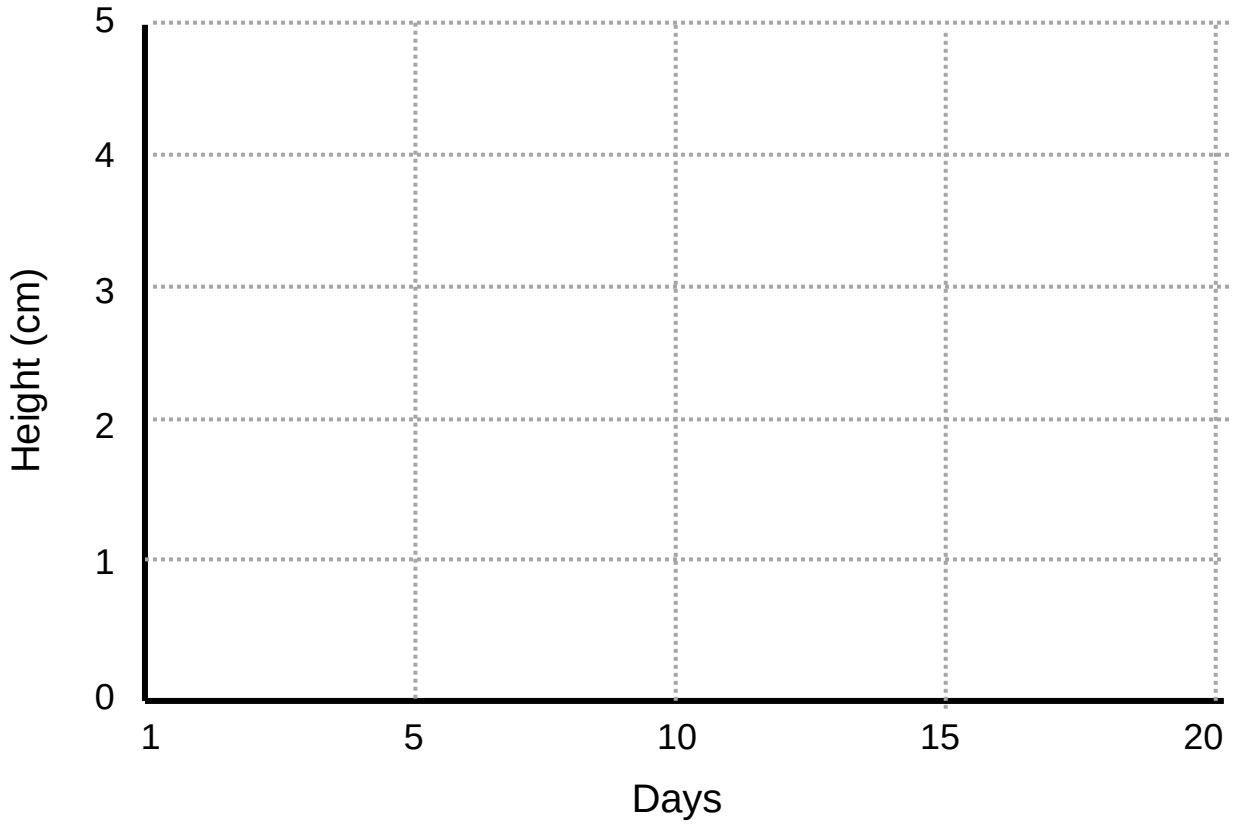
5. Were your results what you expected? Explain. _____

_____

Graph Your Plant's Growth

Create a line graph using your plant height measurements.

- X-axis: Number of days
- Y-axis: Plant height in centimeters
- Plot your measurements and connect the points.



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Space Farmer Experiment

NASA Space Farm Research Report

My experiment was about _____

_____

My hypothesis was _____

_____

I discovered that _____

_____

_____

The data showed that _____

_____

_____

My hypothesis was correct/incorrect because _____

_____

If I repeated this experiment, I would _____

_____

_____

My scientific conclusion is _____

_____

_____

_____

I learned that plants need _____

_____

_____

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Additional Resources

The Moon Chile Challenge
Participate in real space gardening research with this community science chile growing project!

Growing Plants in Space
Learn all about NASA's space gardening programs, including Plant Habitat-04, which cultivated chile peppers aboard the International Space Station.

Growing Vegetables in Space: Eat Like an Astronaut
Learn about some of the plants being grown on the International Space Station

Astrocrops: Growing Plants for Future Space Missions
A set of activities from the European Space Agency.

Videos

Can Plants Grow in Space?
A kid-friendly virtual field trip to introduce space gardening to young kids.

What Plants Can Grow in Space?
Learn about the needs of plants and which ones might grow best in space in this kid-friendly video.

ScienceCasts: Lettuce Orbit Earth
Learn about the challenges of growing plants in space in this 4-minute NASA video.

ScienceCasts: Space Gardening
Learn about how scientists have been studying plant growth on the International Space Station in this 4.5-minute video from NASA.

ScienceCasts: Historic Vegetable Moment on the Space Station
Learn about Veggie, a microgravity garden on the International Space Station that uses clay-based plant pillows, slow-release fertilizers, and red/blue LED lighting.

How Do You Grow Plants in Space?
Learn about how scientists are researching how different species grow in space in this BBC News clip.

This Is What Space Does to Plants
Learn more in this 18-minute video from Floralogic.

How Artemis Astronauts Plan to Grow Plants on the Moon
Watch this WIRED interview with Sharmila Bhattacharya to find out exactly how.

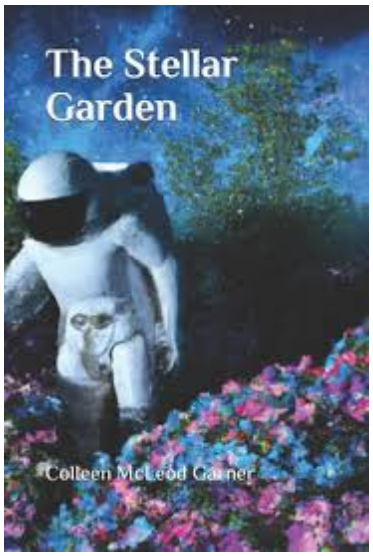
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Book List



Letters From Space
by Clayton Anderson, illustrated by Susan Batori

Told through funny, true-to-life letters from an astronaut, this book includes information about how astronauts grow food in space.
ages 3-7



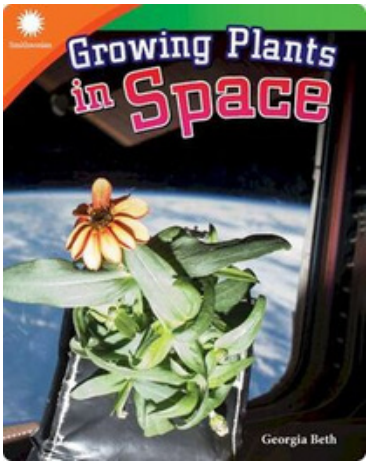
The Stellar Garden
by Colleen McCleod Garner

Follow Luna, an 8-year-old girl with a big dream of becoming a space farmer to grow crops for astronauts and future planetary settlements. Emphasizes hard work and perseverance.
ages 4-8



Ellie the Space Farmer 2: The Moon Garden Mission
by Cesualt Publishing

Ellie travels to the Lunar Research Station to figure out how to grow fresh vegetables on the Moon. The story tackles real space-gardening obstacles—like weak gravity, long nights, dust, and limited water—using creative engineering, LED grow lights, and problem-solving.
ages 5-9

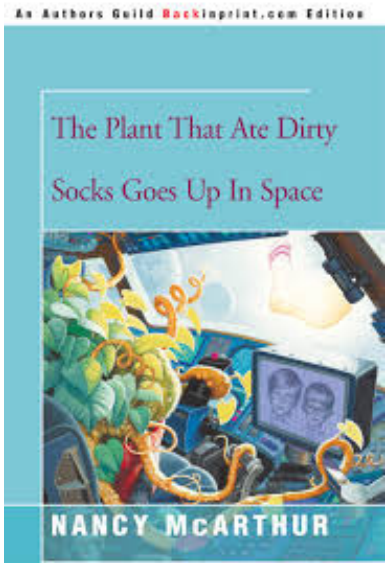


Growing Plants in Space
by Georgia Beth

Learn about the specially trained astronauts called space farmers and the challenges they face. Available on **Epic!**
ages 8-10

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Book List



The Plant That Ate Dirty Socks Goes Up in Space
by Jim Aronsky

A humorous fiction novel in which two giant, sock-eating pet plants are selected for a real Space Shuttle plant experiment, causing chaos and laughter for the astronauts.
ages 8-12



Can We Grow Food in Space? NASA's Space Farming Experiments
by Majed Abualhanud

This book explores real-life NASA missions like the Veggie system and Advanced Plant Habitat on the International Space Station. It explains how plants get water and light without soil or gravity, why fresh food matters for long trips, and how space farming could support future colonies.
ages 7-14

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