SPACE GARDEN

Topic	Keeping healthy in space; space gardening
Objectives	Students will investigate how the unique environmental factors of space can impact plant growth.
Standards and benchmarks addressed	MS-LS1-5 From Molecules to Organisms: Structures and Processes • Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. MS-LS2-4 Ecosystems: Interactions, Energy, and Dynamics (Substandard) • Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Action

Phase 1: Engage

Students will need to complete a prewrite by responding to the following prompt: "Why do you think that Forest Rangers would deliberately start fires in Yosemite National Park?"

Then, have students watch this video: https://www.youtube.com/watch?v=1pp5k9tbM_Q

Next, lead a class discussion about what allows plants to grow and develop in extreme conditions. You can say something like, "There are no harsher conditions than those found in space. Today we are going to look at the conditions and constraints of growing plants in space."

Phase 2: Explore

Students will interact with the following resources in a format of the teacher's choosing (either show each of the following or have students watch the videos separately, and then come together to share what they notice).

https://www.youtube.com/watch?v=c1Gxn_nfgWA
https://www.youtube.com/watch?v=XVbOOMCjktA
https://www.youtube.com/watch?v=9MfWARdoF-o
https://www.youtube.com/watch?v=9JDAZBoLJUc

Then, ask students to respond to the following question in their science notebook: "How have current scientists designed experiments that are unique for the constraints of space?"

Students will now design an experiment that can help simulate the conditions of space on Earth. Students can choose one or two of the following constraints.

- Students will design space gardens that account for at least one of the following constraints:
  - extreme heat
  - extreme cold
  - lack of gravity (upside down garden)
  - no sunlight

Phase 2 *(continued)*

- In their experiment, students need to account for the independent and dependent variables and controls.
- They will also need to account for how they will collect data. For more information, review the NGSS Science and Engineering Practice standards below:
  - Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
  - Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.

Phase 3: Explain

Students will read the following: https://www.ck12.org/biology/Plant-Adaptations/lesson/Plant-Adaptations-BIO/

Ask students how their experimental design will account for and measure plant adaptations. They can revise their experiment based on peer and teacher feedback.

Phase 4: Elaborate

Students can now carry out their experiments. You can purchase https://fastplants.org/product/standard-wisconsin-fast-plants/ which are rapidly growing plant that will allow you to simulate different space constraints.

Phase 5: Evaluate

Students will conclude by writing a lab report or review their peers' experiments, which the teacher will assess for content mastery.