

- Small pom-poms (yellow, blue, red, green)
- Rubber bands
- Scissors
- Sponge

How To:

1. Explore the following challenges of growing plants in space. Brainstorm how you will overcome these challenges when designing your space salad prototype.

Challenge 1: Structure and Gravity

- There is not a lot of room for storage on a spacecraft and every extra ounce of weight requires more fuel. How will you make your device function in a small setting without being big and bulky?
- There is very little gravity in space, so objects will float unless they are anchored down. How do soil, water, and other materials stay in your device?
- Plant cells have rigid cell walls and grow in a structured direction, but without gravity, how does a plant know what is 'up' and what is 'down'? What material would you use to guide your plant's growth so the limited gravity doesn't have a negative impact on the plant?

Challenge 2: Light and Temperature

- Plants need a light source for photosynthesis, which is the process plants go through to grow and create energy from carbon dioxide and water. Where would you position your light source to reach your plants?
- It can get quite dark in space being so far away from the Sun! NASA scientists are experimenting with blue, red, and green light combinations that are most like the Sun's light so that photosynthesis can take place and plants can grow. Which color, or combination of colors, would you use in your lighting system?

Challenge 3: Water Source

- Astronauts transport water to space in 90-pound containers like large duffel bags. How would you connect the water from the storage container to your device?
- The International Space Station has a system that collects and reuses all water in its environment. Does your device create any wastewater that could be recycled?
- Plants return some moisture to the air through their leaves in a process called transpiration. Does your device have a way to collect the transpired moisture?

2. If you are using a box, duct tape along the inside bottom of the box and one inch up the sides to prevent water from seeping out.
3. Review the materials you can use to build a planter that will best help plants grow in space. Remember to consider how gravity will affect growth, plants' need for sunlight, and how your plants would be watered in space. You can use any amount of the materials you want to make your design.
4. Before creating your prototype, wet a sponge, squeeze out excess water, and place in the bottom of the box/pot. This will simulate the amount of water NASA's planters use to water crops in space.
5. Build your planter prototype.

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6. Place soil in the planter, poke seeds into the soil, and brush soil over the top of the seeds.
7. Each week lightly water the plants and watch them grow!

STEM Explanation:

NASA astronauts need a wider variety of nutrition and fresh food sources, so teams of scientists, botanists, and agriculturalists have been trying to find the best solution while taking into consideration the unique environmental needs in space. A few things that make it hard to grow plants in space include: gravity, temperature, sunlight, water, less storage, etc. Unlike on Earth, there is not much gravity in space, so plants get confused about which direction to grow. This means that the device would need to be able to anchor the plant properly. Plants also need light so that they can photosynthesize. A light source must be present on your device so that the plants have an energy source. NASA currently grows lettuce in space using a device called *The Veggie*. By combining blue, red, and green colored lights, NASA has discovered a purple-hue of light that best copies the Sun's UV rays. Plants also need water to help them grow. Since there is little gravity in space, water molecules would flow freely, which means that in our device, we must have a passageway for water to move through to get from the storage container to the plant. Water is a very important resource to have in space, so it is important that it doesn't run out. This means that it would be best to be able to capture any transpired water from the plants to reuse and conserve water. For decades, NASA researchers have been working to develop the best growing device for plants and crops to take into space. They have made some innovations, but are still working hard to create the best environment to grow salad and fresh food in space!



Photo credit: *The Veggie* - Orbital Technologies/NASA

Career Connection:

Botanists, also known as plant biologists, study plants. They understand the anatomy of plants and how these characteristics help plants survive in their habitat. They also study how plants interact with each other and the environment that they live in. Usually botanists pick one type of plant in which to specialize, such as grasses, flowers, trees, or marine plants.

Resources:

www.nasa.gov

<https://www.quora.com/How-many-pounds-of-rocket-fuel-are-necessary-to-propel-1-pound-of-mass-into-Earths-orbit-from-sea-level>

https://www.amazon.com/Lettuce-Seeds-Heirloom-Varieties-Lilianas/dp/B01C0TA52Q/ref=sr_1_7?s=lawn-garden&ie=UTF8&qid=1509041344&sr=1-7&keywords=lettuce+seeds

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