INTERPLANETARY FARMING

FITNESS AND NUTRITION

MISSION DESCRIPTION

In this activity, participants apply their knowledge of space food, food crops, conditions for growth, and nutritional properties of potential food crops to create a shoebox diorama to show how astronauts could consume healthy foods on a different planet.

Difficulty: **MODERATE**

Duration: **100 MINUTES**

Materials: **SUBSTANTIAL**

TIMELINE

Breakdown	Duration
Background	15 minutes
Diorama planning	15 minutes
Diorama making	60 minutes
Clean-up	10 minutes
Total	**100 minutes**

MATERIALS

- Background
- Shoeboxes or other boxes to create diorama (tissue box, etc.)
- Art supplies such as:
  - Glue
  - Magazines for photos
  - Scissors
  - Coloured paper
  - Clay
  - Markers and coloured pencils
  - Glitter
  - Pipe cleaners
  - Foil
  - String or yarn

GOALS

To increase knowledge of food crops, conditions for growth, and nutritional properties of potential food crops for space.

OBJECTIVES

By the end of this activity, participants will:

- List two crops that could be grown on another planet and explain how they contribute to health
- Describe three ways in which growing crops on Earth differs from doing so in space
- Complete a diorama and write a summary explanation of the scene

BACKGROUND

Astronauts travelling to the Moon and Mars will need to stay healthy by consuming balanced meals that are nutritionally adequate. It may be difficult to provide enough packaged foods for astronauts travelling to Mars, so a combination of packaged foods and grown foods is being considered. When identifying crops to be grown for food on the International Space Station (ISS), the Moon, or Mars, it is important to consider the crop's nutrients and growth requirements.

SELECTING CROPS FOR SPACE

Food grown in space is recommended to be a "pick and eat" crop because a Lunar or Martian crew will likely not have a lot of food processing equipment. Once a habitat is established, a crew may have more equipment to process crops to make a greater range of edible foods. For example, a soybean crop can be made into a variety of soybean products like soy beverages, textured soy protein, soy nuts, tofu, soy yogurt, miso, and natto.

Other considerations of potential space crops include:

- Pollination ability
- Edible biomass
- Nutritional value
- Ease of growth
- Size
- Crew's likes and dislikes
  - Flavour, texture, appearance
- Light, nutrient, temperature, water, humidity, and air requirements
- Amount of time to harvest

Some of the potential crops include:

Crop	Example of Nutrients	Approximate Growth Time (days)	Processing Needed Before Consumption
Soybean	Protein, carbohydrates, fats, calcium, magnesium, iron, folate	45-65	Boil in shell
Lettuce (Green Leaf)	Vitamin K, vitamin A, vitamin C	21-28	none
Carrot	Vitamin A, vitamin K, potassium, carbohydrates, fibre	70-80	none
Sweet potato	Vitamin A, vitamin C, carbohydrates, vitamin B6, thiamin, riboflavin, potassium, magnesium, fibre	90-170	Boil or cook
Chickpea	Protein, carbohydrates, fats, magnesium, manganese, iron, folate, fibre	80 days for immature shell beans; 100 days for dried	Eat fresh at 80 days, or cook at or after 100 days
Tomato	Carbohydrates, vitamin A, vitamin C, vitamin K, fibre	50–90	none
Wheat	Carbohydrates, protein, iron, magnesium, phosphorus, B vitamins, folate, zinc, manganese, selenium	213–244 (7–8 months)	Grind into flour
Dill	Vitamin A, vitamin C, manganese, fibre	90	none
Basil	Vitamin K and vitamin A	75	none

PLANT GROWTH ON THE INTERNATIONAL SPACE STATION (ISS)

Vegetables are grown on the ISS to understand how plants grow and function in weightlessness and to see if their nutritional value changes; additionally they provide psychological benefits to the crew. Plants on future space vehicles could help supply the crew with oxygen, recycled water, and fresh food.

Plants are sent to the ISS as seeds. The seeds are then germinated and grown on the Station. For NASA's "Veggie" plant growth system experiments, plant pillows are prepared on Earth and then sent to the ISS. Plant pillows have a precise amount of clay, fertilizer, and seeds. The Advanced Plant Habitat (APH) on the ISS grows a variety of plants in a special growth chamber. The APH has monitoring and environmental control systems to regulate temperature, oxygen, and carbon dioxide levels. The system settings can be adjusted for growing different types of plants. Additionally, the APH is equipped with white, red, blue, and green LEDs so researchers can broaden the types of plants they study in space and tailor the light to that plant's unique needs.

PLANT GROWTH ON A DIFFERENT PLANET

Growing plants on another planetary body, or the Moon, may be challenging, as the environment and atmosphere is very different from Earth's. The Moon's soil does not have the necessary nutrients for plants to survive and grow, so plants would need to be grown in a controlled, closed environment such as a greenhouse.

The main challenges of growing plants on the **Moon** are:

- **Water:** Liquid water is not easily available.
  - Water is accessible near the Moon's poles, but additional water may need to be provided.
- **Light:** At the equator, one Moon-day is 28 Earth-days long, and there are cycles of approximately 14 Earth-days of light and 14 Earth-days of darkness. At the South Pole there is almost constant sunlight.
  - Use of artificial light systems, as needed.
- **Radiation:** The Moon lacks a magnetic field, so it is exposed to space radiation.
  - The plants should be grown in an enclosed area with shielding from the harmful radiation.
- **Atmosphere:** Moon does not have an atmosphere.
  - Atmospheric gases needed to grow plants will need to be provided.
- **Temperature:** At the equator, temperatures can reach 120 °C during the day and 130 °C at night.
  - Temperature regulation systems needed.
- **Soil:** The Moon's regolith does not have the necessary nutrients for plant growth. Lunar soil has the texture of fine dust.
  - Potential use of hydroponic or aeroponic systems.

Additionally, plants grown on the Moon should provide food for the crew with little preparation or processing needed. Ideally, the plants would also have a high percentage of edible biomass.

MISSION PREPARATION

SET-UP

- A few days beforehand, ask participants to gather shoeboxes, tissue boxes, or other small boxes which could be used for their dioramas
- Set up an art supplies area

ACTIVITY

Using information presented in this lesson, participants create a diorama of how they imagine growing food will be like on a planet other than Earth. To complement the diorama, participants can write a brief 250–300 word summary explaining the scene of the diorama and why eating healthy is important for astronauts on a different planet.