An Appetizer for Astronauts

Grade Level: 6-12

Essential Skills: 1, 2, 4, 5, 6, 9

NGSS: MS-ETS1-1, MS-ETS1-2, HS-ETS1-1, HS-ETS1-2

CCSS: 6.SL.1, 6.SL.2, 7.SL.1, 7.SL.2, 8.SL.1, 8.SL.2, 9-10.SL.1, 9-10.SL.2, 11-12.SL.1, 11-12.SL.2

Time: 2-3 class periods

Materials:
An Appetizer for Astronauts Kit* or:
Per Student
- Microgreen seeds
- Planting container (with holes)
- Nesting container(1020 flat, baking sheet or a container without holes)
- Soil
- Water
- *An Appetizer for Astronauts* worksheet
- *Growing Microgreens* PowerPoint
- *Steps to Growing Microgreens* worksheet (optional)

AITC Library Resources:
More Lessons:
Greenhouse Prototype Challenge
Hen House Engineering
Hungry Plants

Description:
Garnish your space travel with sweet or spicy microgreens! Students will use the *Engineering Design Process* to design a growing system and device to secure the growing plants that is able to withstand the lack of gravity while growing a tasty treat for them to enjoy!

Activity Directions:
Introduction: Meals for Trips
1. Invite students to create a list of foods they would take with them if they were going on vacation.

2. Ask students to share some of the foods that they included on their list.

3. Ask students to consider the following questions:
   a. If you were restricted to a small backpack full of food, would all the items on your list fit?
   b. If there was no refrigeration, would that change the foods you listed to bring?

4. Explain to students that astronauts travel into space for multi-week trips and have to plan their meals carefully due to limited technology and storage space on the ship. Today, we are going to explore meals and bring new fresh food solutions to space travel.

Part 1: A Day in Space Life
1. Invite students to watch *Train Like an Astronaut: You are what you eat...so what do Astronauts eat?* and/or *How to Prepare (Thanksgiving) Food in Space* by NASA Johnson. Instruct students to take notes on how their foods they planned for their "vacation" differed from that of the diet of an astronaut.

2. After watching the video, ask students to share their observations from the video.

3. Explain to students that they'll be challenged with creating some new fresh food options to add to an astronaut's diet.

4. Divide students into groups of 3-4 students and distribute a copy of the *Appetizer for Astronauts* worksheet to each student.

5. As a class review the scenario on the top of the worksheet. Explain to students that they will need to develop a growing system to grow microgreens and develop a device to secure the plants from floating while astronauts are growing them in space.

6. Invite students to complete Step 1 of their assignment based on the scenario provided.

7. Review the *Criteria and Constraints* of the project with students listed on the worksheet. Make sure to adjust the materials listed under constraints if any additional materials will be provided to students.

Part 2: Research and Develop Solutions

1. Instruct groups to complete Step 2 of their worksheet. Explain to students that they will be creating a list of questions to research to begin to plan a solution to the scenario. Give students about 10-15 minutes to brainstorm questions.

2. As a class, review the questions students came up with in their groups. Make sure students have the following questions listed:

   a. What kinds of meals do astronauts eat?
   b. Do astronauts have access to water?
   c. How do you keep objects from floating in space? How can we keep the plant from floating?
   d. How do you grow microgreens?
   e. What materials are needed to grow microgreens?
   f. What is the recommended seed density to plant microgreens at?

3. After, provide groups with time to research the list of questions.

4. Review the *Growing Microgreens* PowerPoint with students to provide some background information to help them plan their solution.

5. Instruct students to pay close attention to the Seed Density calculations as they will need to do this to determine how many seeds to use in their planting containers. There is a *Steps to Growing Microgreens* worksheet included in this lesson containing planting and seed density calculation information for students to reference, if needed.

6. After students have completed their research, invite students to complete Step 3 and 4 on their *Appetizer for Astronaut* worksheet. Explain to students that their group will be creating a device that should allow 3-4 planted microgreen containers to grow in space.

7. After students have developed a plan and sketched it, the group should present their plan to the teacher. Upon approval, provide students with the materials allotted to their group. Each group of students should receive 3-4 growing containers, allotted seed amount based on seed density calculations, 3-4 nesting trays and an assortment of craft materials.

8. Students should continue to Step 5 and build a prototype of their growing method for microgreens and the device to secure it from floating as they grow in space. Students should plant their microgreens and use the device to see if the microgreens will grow using their securing device.

9. Students should observe the growth and development of their plants over the next 7-21 days to determine if a plant will be able to grow in the conditions they developed.

10. After about 15 days of growth, have students share their prototype and microgreens growth results with the class.

11. Instruct students to complete Step 7 to evaluate whether they would change anything in their plans based on other groups projects and challenges they encountered. Discuss the answers as a class.

Resources for Student Research

The ABCs of Microgreens, Penn State Extension

Small but Mighty: Microgreens go from trendy vegetables to functional food, Penn State Extension

What do astronauts eat in space?, Royal Museums Greenwich

Best Diet for Astronauts: Here's How Scientists Build Menu for Space Travelers, The Science Times
How do astronauts eat in space?, Kennedy Space Center

Eating in Space, NASA

Sleep: How can they Seep when they are floating in Space?

Activity Page

Appetizer for Astronauts

Name: _____

Astronauts travel into space for several months at a time. They must bring food for their entire period of travel. Their food generally consists of shelf stable food, freeze-dried meals or dehydrated foods. NASA nutritionists work to ensure the astronaut's food has enough calories, vitamins and minerals for floating passengers. Fresh fruits and vegetables are challenging to provide to astronauts and often times have a limited shelf-life and take up precious cargo space. NASA is exploring options for growing fruits and vegetables in space. With limited space on the space shuttle, a small growing system is needed. NASA has partnered with the class to develop a growing method to grow microgreens and a solution to secure the microgreens as they grow.

Step 1

Identify the Problem and Constraints

A technological problem may be solved through the development or improvement of technology.

1. What is the problem?

2. What will solving this problem accomplish?

Criteria	Constraints
Criteria = a set of standards that determines whether a solution is successful or not.	Constraint = limitations on the solution
• Your solution must be able to successfully grow microgreens • Your solution must secure microgreens so it will not float in space. • You solution needs to have minimal inputs as resources are limited in space.	You will be provided: • Microgreen seeds • Soil • 3-4 microgreens growing container and nesting tray • Water • Assorted craft materials

Step 2

Research

Research to determine the best solution for NASA. Brainstorm a list of questions that you need answers to that will help you determine a solution.

Step 3

Imagine: Brainstorm Possible Solutions

List and describe 3-5 prototype ideas. Include information about growing methods, watering and the technology to keep the planted microgreens from floating in the air.

Step 4

Plan: Select the Best Solution

Evaluate the positive and negative points of each idea from your brainstorm list, consider the criteria and constraints and choose what you think is the best solution. Describe it in detail below and sketch the design.

Step 5

Create: Build a Prototype

Review the plan with your teachers and gather the materials provided for the build. Build the structure and plant the microgreens to test your structure. Check the box when it's complete to move onto the next step!

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Step 6

Test and Evaluate

Test your system to ensure it works! Observe the growth of the microgreens in your system over the next 14 days. Track the growth of the microgreens in a notebook. Check the box after you have observed and tested your prototype.

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Step 7

Improve: Change your design if needed!

After you have tested your prototype, evaluate the structure using the questions below.

1. What worked well?

2. What did not work?

3. What would you change about your prototype design?

4. Are there any materials that would help make your design more successful?

Activity Page

Steps to Growing Microgreens

Name: _____

Directions: Follow the steps below to plant microgreens and calculate the recommended Seed Density.

Step 1: Calculate the area of the container you will use to grow seeds in.
To determine the amount of seeds needed for the provided container, start by determining the area of the container.

Circular shaped containers: Area = π x diameter^2 ÷ 4

Square or rectangular shaped containers: Area = width x length

Step 2: Determine the amount of seeds to plant in the container.
As a general rule, plant 10-12 seeds per inch for small seeds or 6-8 seeds per inch for larger seeds.

1. Calculate the total number of seeds per container using the formula below. With your teacher, determine the amount of seeds per inch to use in the calculation based on the size of seeds that will be provided.

Number of seeds per container = Seeds/sq. in x Area

Step 3: Plant your microgreens!
1. Fill the planting container (with holes) nearly full with soil.

2. Fill the nesting container (no holes) half full of water, place your planting container in the nesting container to begin to wet the soil.

3. Once the soil has soaked up the water and is moist, remove the container from the water.

4. Using the number of seeds determined in **Step 2**, evenly distribute seeds across the container.

5. After the excess water has been removed from the nesting container, place your planted container back in it.

6. Place the planting container in a dark area until germination has occurred. If needed spray the soil with a water spray bottle to keep the area moist during germination or add water to the nesting tray.

7. After the seeds have germinated, place the trays in an area where they will be in direct light near a window.