



## Food for Thought

### DESCRIPTION

Space food research meets the challenge of providing food that tastes good and travels well in space. This lesson emphasizes inquiry and cooperative involvement of students as they explore the unique problems of keeping astronauts happy and healthy in space.

### OBJECTIVES

Students will

- Integrate science, technology, engineering, and mathematics with space food nutrition, selection, preparation, and safety
- Plan and develop a 5-day balanced food menu for astronauts on the International Space Station

### NASA SUMMER OF INNOVATION UNIT

*Life Science—Food*

### GRADE LEVELS

4 – 6

### CONNECTION TO CURRICULUM

*Science, Technology, and Mathematics*

### TEACHER PREPARATION TIME

1.5 hours

### LESSON TIME NEEDED

7 hours

*Complexity: Moderate*

## NATIONAL STANDARDS

### National Science Education Standards

#### *Science as Inquiry*

- Understanding of scientific concepts
- Abilities necessary to do scientific inquiry
- Skills necessary to become independent inquirers about the natural world
- The dispositions to use the skills, abilities, and attitudes associated with science

#### *Life Science*

- Characteristics of organisms
- Organisms and environments
- Structure and function in living systems

#### *Science in Personal and Social Perspectives*

- Personal health
- Types of resources
- Changes in environments
- Science and technology in society

### Common Core Math Standards

#### *Measurement and Data*

- Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit
- Represent and interpret data

### Technology Education Performance Indicators for Students

#### *Creativity and Innovation*

- Apply existing knowledge to generate new ideas, products, or processes

#### *Research and Information Fluency*

- Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
- Process data and report results

### *Critical Thinking, Problem Solving, and Decision Making*

- Identify and define authentic problems and significant questions for investigation
- Plan and manage activities to develop a solution or complete a project
- Collect and analyze data to identify solutions and/or make informed decisions
- Use multiple processes and diverse perspectives to explore alternative solutions

## **MANAGEMENT**

Review the activities and background information carefully before having the students do each activity in the lesson. You can use the Discussion Questions in this lesson to prepare the students for what they will learn doing the activities. The students should work in small groups. Prepare the materials for each student group before beginning the lesson. The activities require students to handle and sample food items. Remember to encourage and practice food safety while handling the food items and utensils to ensure cleanliness and hygiene. Also, determine if students have any food allergies, particularly peanuts, before beginning the lesson.

## **CONTENT RESEARCH**

From John Glenn's mission to orbit Earth to the International Space Station program, space food research has met the challenge of providing food that tastes good and travels well in space. To better understand this process, we can look back through history. Explorers have always had to face the problem of how to carry enough food for their journeys. Whether those explorers are onboard a sailing ship or on the space shuttle, adequate storage space has been a problem. Food needs to remain edible throughout the voyage, and it also needs to provide all the nutrients required to avoid vitamin-deficiency diseases such as scurvy.

Early in history, humans discovered that food would remain edible longer if it were dried and stored in a cool dry place until it was time to be consumed. Early food dehydration was achieved by cutting meat, fish, and certain fruits into thin strips and drying them in sunlight. Rubbing food with salt or soaking it in salt water, an early form of curing food, also helped preserve it. Later techniques were developed for cooking, processing, preserving, and storing food in sealed containers. With the development of pasteurization and canning, a much larger variety of foods could be stored and carried on long journeys. More recently, refrigeration and quick-freezing have been used to help preserve food flavor and nutrients and prevent spoilage.

While these forms of packaged food products are fine for travel on Earth, they are not always suitable for use on space flights. There are limitations to weight and volume when traveling, and the microgravity conditions experienced in space also affect the food packaging. Currently, there is limited storage space and no refrigeration. To meet these challenges, special procedures for the preparation, packaging, and storing of food for space flight were developed.

Additional content can be found in the introduction of the NASA curriculum guide, Space Food and Nutrition, at the following Web site:

[Space Food and Nutrition - Educators Guide](#)

## **MATERIALS**

*(See each activity for detailed materials list.)*

- Package instant pudding mix
- Package instant drink crystals
- Sugar
- Artificial sweetener
- Nonfat dry milk
- Water
- Straws
- Plastic spoons
- Plastic zip-locking sandwich bags
- Paper plates
- Fruits such as apples and bananas
- Vegetables such as carrots and celery sticks
- Vitamin C tablets
- Small deep plastic bowls
- Plastic knife
- Plastic zip-locking sandwich bags
- Marking pen
- Tape
- Metric balance or digital scale
- Plastic zip-locking snack and sandwich bags
- Metric rulers
- Calculators

## Key Concepts

- Food and drink are essential for astronauts to survive in space.
- Safe, efficient, and proper methods of food storage are critical for space travel.
- Astronauts need a balanced diet to maintain their health and energy during space flight.
- The proper storage and disposal of waste is important in planning space missions.

## Key Terms

- **Intermediate Moisture Food:** Foods preserved by taking some water out of the product while leaving enough in to maintain the soft texture and can be eaten without any preparation
- **Irradiated Food:** Food that has been preserved by exposure to specific heat or light radiation
- **Natural Form Foods:** Foods that can be eaten without additional processing
- **Rehydratable Food:** Food that has been preserved by removing the water; water is added to the food before it is eaten
- **Thermostabilized Food:** Food that has been preserved using heat to destroy harmful bacteria

## LESSON ACTIVITIES

The activities listed below are needed to complete this lesson. They can be accessed at the following Web sites:

### Food Preparation for Space

The students will measure the proper amounts and mix ingredients of rehydratable foods and drinks.

[http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Food\\_Preparation\\_Space.html](http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Food_Preparation_Space.html)

### Food Selection

The students will determine the acceptability of food products for space flight by participating in a sensory taste panel.

[http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Food\\_Selection.html](http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Food_Selection.html)

### How Much is Waste?

The students will measure the mass and volume of a food package before and after repackaging for space flight, and determine the usable and waste portions of food selected for space flight.

[http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/How\\_Much\\_Waste.html](http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/How_Much_Waste.html)

### Mold Growth

After observing mold growth on different types of bread, the students will measure and record the growth rate.

[http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Mold\\_Growth.html](http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Mold_Growth.html)

### Planning and Serving Food

The students will plan a 5-day flight menu and design a food tray that can be used in space.

[http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Planning\\_Serving\\_Food.html](http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Planning_Serving_Food.html)

### Ripening Fruits and Vegetables

The students will compare and contrast the rate of ripening of fruits and vegetables when exposed to air and the effect of using a chemical inhibitive on that rate of ripening.

[http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Ripening\\_of\\_Fruits\\_and\\_Vegetables.html](http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Ripening_of_Fruits_and_Vegetables.html)

## ADDITIONAL RESOURCES

For additional resources and activities to enhance this lesson, refer to the following resources:

Space food Web site

<http://spaceflight.nasa.gov/living/spacefood/index.html>

Liftoff to Learning, *Living and Working in Space*, video

<http://quest.arc.nasa.gov/space/teachers/liftoff/living.html>

NASA Space Food Gallery

[http://www.nasa.gov/audience/formedia/presskits/spacefood/gallery\\_food.html](http://www.nasa.gov/audience/formedia/presskits/spacefood/gallery_food.html)

## DISCUSSION QUESTIONS

The following questions can be discussed with the students as an introduction to the lesson (answers will vary based on students' pre-lesson knowledge and should not be considered correct or incorrect, but only to motivate discussion).

- Have any of the students ever eaten "space food"? *They will most likely answer "no," but in actuality, space food is the same as food purchased in grocery stores. The main difference is the way they are prepared and packaged.*
- How is space food different or similar to food purchased at any local grocery store? *Preparation and packaging.*
- What foods would be best for space travel and why? *Foods that will not spoil easily and do not create a mess during consumption.*
- What foods would NOT be good for space travel and why? *Foods that will spoil easily and create a mess during consumption.*
- Are the nutritional requirements for astronauts in space the same for those of us here on Earth? *Yes, for the most part, but that depends on physical activity of the astronaut.*

## ASSESSMENT ACTIVITIES

- Observe and assess student performance throughout the activities.
- Ask each student group to report the results of their activities with the class to compare and contrast with other student groups.
- Each individual activity in this lesson contains assessment activities. Refer to those activities for additional assessments.
- Have the students write procedures to make a rehydratable food and drink.

## ENRICHMENT

- Students can design and test a new and improved microgravity coffee cup for making mealtime in space easier and more enjoyable for astronauts.
- The FIRST LEGO League (FLL) 2011 competition, Food Factor, addresses food safety concepts and design. Students can research and participate in this competition. For information, refer to the FLL Web site.  
<http://www.firstlegoleague.org/media/twocol.aspx?id=248>