



NASA Food Technology Commercial Space Center

Fresh Foods in Space – Un**SENSOR**ed by Toshiba L. Traynham

BACKGROUND Just like people on Earth, astronauts must eat to survive while in space. The foods astronauts consume during space missions have evolved over the years. Fresh foods, such as fruits, vegetables, and bread are now routinely taken into space aboard the Space Shuttle and the International Space Station (ISS).

On Earth, refrigeration of food is necessary to maintain fresh food quality, and more importantly, to deter the growth of spoilage microorganisms. Fruits and vegetables can be kept for 2-3 weeks in refrigeration (4°C, 39°F) on Earth before they are consumed.

Aboard the Shuttle or ISS, fruits and vegetables must be consumed within seven days after a launch. The Shuttle and ISS do not have refrigerators, so most fresh foods have to be stored at room temperature (25°C, 72°F). Warm temperatures allow for the rapid growth of spoilage organisms and cause the quality of fruits and vegetables to diminish. If spoilage organisms are consumed in high amounts, mild sickness could occur. This may jeopardize the health of all astronauts aboard the Shuttle or ISS. As quality decreases, fruits and vegetables will also become less appealing to sight and taste.

It is very important that astronauts have a variety of safe, nutritious, and palatable foods to eat in order to maintain good health during space missions. In this lesson, students will be able to observe changes in fresh food quality as influenced by temperature and time.

Audience: This lesson is designed for children in grades 1-5 but is adaptable to all grade levels.

Time: This lesson requires three or four sessions, lasting 30-40 minutes each (preferably following an alternate day pattern).

LESSON SUMMARY

Students will compare the sensory characteristics of fruits and vegetables stored at room temperature to those stored at refrigeration for five days. As the fresh foods begin to decay, students will develop written observations about their physical attributes (i.e. color and texture) based on a sensory evaluation scale that is provided. The lesson incorporates the four core areas of elementary curriculum: social studies/history, math, language arts, and scientific investigation.

Space Food

1. Students will name two examples of storage requirements for fresh fruits and vegetables aboard space vehicles.
2. Students will identify at least one physical change with respect to color and texture attributes that selected produce may undergo aboard a Shuttle for five days of storage at room temperature.

**STUDENT
LEARNING
OUTCOMES**

Communication

1. Students will develop communication skills within a team by performing the tasks of the lesson using the assigned formal roles of team leader, team recorder, and team members (*see notes for facilitator*).
2. Students will present and interpret written communication of sensory perceptions by formulating bar graphs based on their observations.

Learning

1. Students will critically evaluate and interpret scientific data.
 2. Students will convert qualitative observations into quantitative data.
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**ASSESSMENT/
EVALUATION**

At the end of each evaluation day, students will discuss the following questions:

1. What did the celery/strawberry look like at the beginning of the experiment?
2. How has the celery/strawberry color/texture changed after three days; after five days?

On the last evaluation day (or days later), students will discuss the following questions:

1. What do you think is the best way to store the celery/strawberries for a long period of time on Earth; in space? Base your answers on the physical changes that you observed.
 2. Would your answer be the same for milk, bread, and/or soda (additional food items may be discussed)?
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MATERIALS

This lesson requires the following materials:

- fresh celery stalks (1 bag)
- strawberries (20-25)
- plastic trays
- paper towels
- magnifying glass (2)
- thermometer (2)
- refrigerator
- pencils
- data observation worksheet (2 per team)
- sensory evaluation scorecards (3 per team)

Pre-Activity Instructions:

Wash all produce in lukewarm water and dry. Cut celery into 3” sticks. Place three celery sticks and two strawberries on paper towels and label two sets per team. Place sets of strawberries and celery on plastic trays, designating one tray for refrigeration and the other for room temperature storage.

INSTRUCTIONS GIVEN TO STUDENTS Teams will view the celery and strawberry (refrigerator and room temperature) and evaluate the color and texture of each. Use the magnifying glass to observe texture or color features that may be too small to see.
For celery, one stick should be broken in half for texture observations. Strawberries should be lightly touched or squeezed.

The team leader should discuss what score should be given for each food with the team recorder and member(s). The team recorder should record the score that the team decides upon as the best description of the food's color and texture.

The scores for the refrigerated and non-refrigerated foods should be recorded for each day of the experiment as a graph on the observation data sheet. (See Attachment 2.) You will perform the same tasks on days 3, 5, and 7 (i.e. today, day after tomorrow, etc).

NOTES FOR FACILITATOR

Prior to beginning the first experiment day:

Prepare a 15-30 minute lesson on space food and produce deterioration concepts for students, such as "Why does food spoil?"

"Maturity, Ripening, Packaging and Storage of Small Fruit Crops"
Virginia Polytechnic Institute & State University, Department of Horticulture
www.hort.vt.edu/faculty/williams/hort4744/maturity-notes.pdf

"Fresh Ideas For Space Food" National Aeronautics and Space Administration (NASA), NASAexplores,
www.nasaexplores.com/previous_topics/previous_all.php

"Eat Right For Long-Distance Flight" National Aeronautics and Space Administration (NASA), NASAexplores
www.nasaexplores.com/previous_topics/previous_all.php

"NASA National Aeronautics and Space Administration"
<http://www.nasa.gov/audience/forstudents/k-4/home/index.html>

Discuss the responsibilities of formal team roles. (See below.) Designate who will serve as the team leader, recorder and member(s) for the first experiment day. These roles should be rotated.

Team Role: A team role designates a certain behavior expectation for the individual assuming or assigned that role. Formal roles allow the group or team to accomplish its goals in an orderly fashion.

Team Leader Responsibilities

- shares information between team and instructor
- conducts team activities or assignments
- keeps team on track
- supports the team

Team Recorder Responsibilities

- writes-up complete documents
- maintains team correspondence and other documents
- helps make team decisions

Team Member Responsibilities

- participates fully in team assignments
- upholds team ground rules
- helps make team decisions

Discuss and review sensory descriptions with students provided on the sensory evaluation scorecard. (See attachment 1)

Place students into teams of 4-5. Decide on a team name. (See list of names below.)

Team (*fill in the blank*)

Apollo	Discovery	Pathfinder	Pioneer	Cosmos
Challenger	Endeavor	Columbia	Voyager	Genesis
Atlantis	Enterprise	Helios	Aeros	Hawkeye

KEY TERMS

space	Earth	spoil	temperature	food quality
NASA	sensory	astronaut	color	space mission
rehydrate	physical change	shuttle	texture	fruit
dehydrate	microorganisms	space station	data	vegetable
attribute	observation	evaluate	Celsius (°C)	refrigerator

OPTIONAL ACTIVITIES

If you have more time, consider the following activities to build on this lesson.

- During the introductory lesson, have students complete sensory evaluation of a particular fruit or vegetable, i.e. bananas. Have students describe sensory perceptions related to color, texture, and taste using the sensory scorecard provided or a similar version.
- Using a digital camera, take pictures of the fruits and vegetables on each observation day. Use these photos for discussion at the end of each experiment day.
- Use the sensory evaluation scores from each team to formulate one large bar graph.

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Sensory Evaluation Scorecard

STRAWBERRY (refrigerator)

Color score _____	5 = red	2 = light red
	4 = medium red	1 = pink
	3 = not red or pink	
Texture score _____	5 = very hard	2 = soft
	4 = hard	1 = very soft
	3 = not hard or soft	

STRAWBERRY (room temperature)

Color score _____	5 = red	2 = light red
	4 = medium red	1 = pink
	3 = not red or pink	
Texture score _____	5 = very hard	2 = soft
	4 = hard	1 = very soft
	3 = not hard or soft	

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 CELERY (refrigerator)

Color score _____	5 = green	2 = light green
	4 = medium green	1 = white
	3 = not green or white	
Texture score _____	5 = very hard (breaks with effort)	2 = soft
	4 = hard	1 = very soft
	3 = not hard or soft	(breaks without effort)

CELERY (room temperature)

Color score _____	5 = red	2 = light red
	4 = medium red	1 = pink
	3 = not red or pink	
Texture score _____	5 = very hard (breaks with effort)	2 = soft
	4 = hard	1 = very soft
	3 = not hard or soft	(breaks without effort)

Team _____

Fruit/vegetable name _____

OBSERVATION DATA SHEET

Instructions: Record the observation day and temperatures before you begin. Color in the number of bars equal to the sensory evaluation score recorded for the strawberry or celery.

Color

6						
5						
4						
3						
2						
1						
	Day	Day	Day	Day	Day	Day
	_____ °C	_____ °C	_____ °C	_____ °C	_____ °C	_____ °C
	Refrigerator			Room Temperature		

Texture

6						
5						
4						
3						
2						
1						
	Day	Day	Day	Day	Day	Day
	_____ °C	_____ °C	_____ °C	_____ °C	_____ °C	_____ °C
	Refrigerator			Room temperature		