SPACE FOOD AND NUTRITION
An Educator’s Guide With Activities in Science and Mathematics
Space and Food Nutrition—An Educator’s Guide With Activities in Science and Mathematics is available in electronic format through NASA Spacelink—one of the Agency’s electronic resources specifically developed for use by the educational community.

The system may be accessed at the following address: http://spacelink.nasa.gov/products
Space Food and Nutrition
An Educator’s Guide With Activities in Science and Mathematics

Acknowledgments

National Aeronautics and Space Administration
Office of Human Resources and Education
Education Division
Washington, D.C.

Education Working Group
NASA Johnson Space Center
Houston, Texas

Writers
Angelo A. Casaburri
Aerospace Education Services Program
NASA Johnson Space Center
Houston, Texas

Cathy A. Gardner
Dickinson Independent School District
Dickinson, Texas

Editor
Jane A. George
Teaching From Space Program
NASA Headquarters
Washington, D.C.

Special thanks to the following contributors and reviewers

Charles T. Bourland, Ph.D.
System Manager, Space Station Food
Flight Crew Support Division
NASA Johnson Space Center

Debbie A. Brown
ISS Education Liaison
Education Working Group
NASA Johnson Space Center

Gregory L. Vogt, Ed.D.
Crew Educational Affairs Liaison
Education Working Group
NASA Johnson Space Center

Karol L. Yeatts, Ed.D.
1998 Einstein Fellow
Miami Dade County Public Schools
Miami, Florida
### National Science Education Standards

#### Activity Matrix

**National Science Education Standards**

*National Research Council, 1996*

*Grades K–8*

<table>
<thead>
<tr>
<th></th>
<th>Food Preparation for Space</th>
<th>Food Selection</th>
<th>Planning and Serving Food</th>
<th>Classifying Space Food</th>
<th>Ripening of Fruits and Vegetables</th>
<th>Mold Growth</th>
<th>How Much Is Waste?</th>
<th>Dehydrating Food for Space Flight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science as Inquiry</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abilities necessary to do scientific inquiry</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Life Science</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Matter, energy, and organization in living systems</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Science in Personal and Social Perspectives</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Personal Health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Physical Science</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Properties of objects and materials</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position and motion of objects</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

*Space Food and Nutrition*  
An Educator's Guide With Activities in Science and Mathematics, EG-1999-02-115-HQ • V
### National Mathematic Standards

#### Activity Matrix

**National Mathematic Standards**  
National Council of Teachers of Mathematics, 1988  
Grades K–8

<table>
<thead>
<tr>
<th>Computation</th>
<th>Food Preparation for Space</th>
<th>Food Selection</th>
<th>Planning and Serving Food</th>
<th>Classifying Space Food</th>
<th>Ripening of Fruits and Vegetables</th>
<th>Mold Growth</th>
<th>How Much Is Waste?</th>
<th>Dehydrating Food for Space Flight</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Measurement</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Reasoning</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Observing</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Communicating</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Introduction

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 developments 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.