National Aeronautics and Space Administration

food for thought

Educational Product	
Educators and Students	Grades 5-8

www.nasa.gov
EG-2011-08-00005-SSC

Food for Thought: Eating in Space

Table of Contents

Acknowledgements

Authors
- Gregory L. Vogt, Ed.D.
- Deborah A. Shearer, M.S.

Editor
- Shannon Simpson

Food for Thought Logo / Poster Design
- Angela Lane

Food for Thought Web Design
- Ken Christian

Special Thanks To:

NASA Headquarters
- Leland Melvin
- James Stofan
- Shelley Canright, Ph.D.
- Alotta Taylor

NASA Johnson Space Center
Teaching From Space Office
- Cynthia McArthur
- Becky Kamas
- Matthew Keil
- Kelly McCormick

NASA Johnson Space Center
Space Food Systems Laboratory
- Vickie Kloeris
- Jennifer Brogran

Louisiana State University
- Brenda Nixon, Ph.D.
- Ian Binns, Ph.D.
- Pamela Blanchard, Ph.D.

The University of Southern Mississippi
- Sherry Herron, Ph. D.

NASA Stennis Space Center
Office of Education
- John Boffenmyer
- Ken Christian
- Christopher Copelan
- Steve Culivan
- Joshua Finch
- Cheryl Guilbeau, Ed.D.
- Randall Hicks
- Barbara Murphy
- Emma Seiler
- Sherrill Reynolds
- Katie Veal Wallace
- Kelly Witherspoon, Ph.D.

National Curriculum Standards

For Grade Levels 5-8

	Mars Needs Food!	Always Wash Your End Effectors!	Now That's A Cup of Coffee!	If You Give An Astronaut A Cookie
MATHEMATICS STANDARDS[1]				
Operations and Algebraic Thinking				
• Write and interpret numerical expressions				
• Analyze patterns and relationships				
Number and Operations in Base Ten				
• Understand the place value system				
• Perform operations with multidigit whole numbers and with decimals to hundredths				
Measurement and Data				
• Convert like measurement units within a given measurement system				
• Represent and interpret data				
SCIENCE STANDARDS[2]				
Science as Inquiry				
• Understanding of scientific concepts				
• Understanding of the nature of science				
• The dispositions to use the skills, abilities, and attitudes associated with science				
Earth and Space Science Standards				
• Earth in the solar system				
Science and Technology Standards				
• Abilities of technological design				
• Understanding about science and technology				

SCIENCE STANDARDS[2]				
Life Science Standards • Structure and function of living organisms	🍪	🍪		
• Regulation and behavior	🍪			
Science in Personal and Social Perspectives • Personal health	🍪	🍪		🍪
• Populations, resources, and environments	🍪	🍪		
• Risks and benefits	🍪	🍪		
• Science and technology in society	🍪	🍪	🍪	🍪
TECHNOLOGY STANDARDS[3]				
Creativity and Innovation • Apply existing knowledge to generate new ideas, products, or processes		🍪	🍪	🍪
• Create original works as a means of personal or group expression		🍪	🍪	🍪
Communication and Collaboration • Contribute to project teams to produce original works or solve problems		🍪	🍪	🍪
Research and Information Fluency • Plan strategies to guide inquiry	🍪	🍪	🍪	🍪
• 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	🍪	🍪	🍪	🍪

[1] Common Core State Standards for Mathematics (Common Core State Standards Initiative, 2010)

[2] National Science Education Standards (The National Academies Press, 1996)

[3] The ISTE NETS and Performance Indicators for Students (International Society for Technology in Education, 2007)

Mars Needs Food!

Quick Look

Among the thousands of questions that need to be answered before astronauts travel to distant planets and asteroids are questions related to the astronauts themselves. How much food will they need and what foods can they take? We are fortunate on Earth to have an amazing variety of foods to eat.

When astronauts do go to Mars and other destinations, mission crews will be international. Carrying food the entire crew likes will be a real challenge. In this two-part activity, student teams will learn how to determine calorie requirements of astronauts and plan a one-day menu for an American astronaut and one for an international astronaut. In an optional extension to this activity, teams can learn how the calorie content (energy contained) in different foods is determined. They will measure the energy in several foods using a calorimeter they construct from simple materials.

Objectives

- Student teams will research the caloric content and nutritional value of space foods.
- Student teams will construct one-day space food menus for an American and an international crew member.

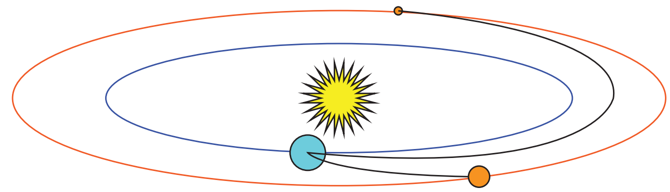
For the extension

- Students will construct and use calorimeters to measure the kilocalories (energy) contained in several food samples.
- Students will learn and practice safety procedures during their testing.

Background

Some day, humans will travel to the planet Mars. Their journey will be the most ambitious space mission ever. Most likely, the mission will combine efforts of NASA and its many partner space agencies around the world.

Going to Mars will be far more challenging than going to the Moon. First, there is the distance problem. Traveling to the Moon took three days. At best, when Earth and Mars are closest, Mars is still a three- to six-month trip in a high-speed rocket. But because of the different orbits of Earth and Mars, Mars is usually much farther away - sometimes on the far side of the Sun. The total round-trip mission will probably take two years.



Timing is Everything
Because Mars and Earth travel on independent orbits, a typical round-trip mission will take about two years. About half of that time will be spent traveling to and from Mars. Depending upon the speed of the spacecraft, a one-way interplanetary flight will take between three and six months provided the flights begin when Earth and Mars are near each other. If Mars and Earth are on opposite sides of the Sun, the flights themselves could take a year or more each way.

While on the mission, what will the crew do about food, water, and oxygen? One idea is to send robotic factories to Mars ahead of the crew. The factories could process oxygen from the Mars atmosphere, collect water from subsurface deposits, and robot gardeners could grow and store food.

With this plan, the food and oxygen for the stay on Mars will be taken care of, but what about travel to and from the planet? Only so many supplies can be carried. Otherwise a huge, very expensive spacecraft and an even larger, extremely expensive rocket will be needed for the round trip.

Fortunately, both water and air can be recycled. Astronauts are already doing this on the International Space Station (ISS). (Yes, they are processing urine back into safe drinking water!) Food is another matter. Every bit of food needed will have to be packed onboard. No matter how desperate the crews become in transit, they can't send out for a pizza delivery.

What foods will they take?

<u>Food is Energy</u>

Every moment of your life, whether awake or asleep, you are using energy for muscles, breathing, powering internal body processes, and even for thinking. Where do you get that

Astronaut C. Michael Foale burning up kilocalories on a treadmill on the International Space Station. In microgravity, a harness with elastic cords is needed to keep Foale's feet on the treadmill surface.

energy? The answer is simple: food.

Food contains energy. That is the main reason why we eat food - to replenish our energy supplies. Therefore, people planning the Mars trip have to consider which foods will provide the most energy in relation to its mass and volume. For example, which would make more sense for a Mars mission, a fluffy doughnut or the same mass of walnuts? While the doughnut might be the fun choice, walnuts will take less space and pack more energy (and keep longer).

Deciding which foods to take and how much also depends upon who is on the crew. A 6-foot-tall, 200-pound male astronaut will need more food than a 5-foot-2-inch-tall, 120-pound female astronaut. Each crew member has different energy needs. Individual energy needs have to be estimated before even thinking about what foods to take.

The key to estimating individual energy needs is a measurement called basal metabolic rate or BMR. BMR means the rate at which a body uses energy for life processes. It is determined by knowing a person's sex, height, mass, and age. These factors impact body energy needs.

BMR is based on metric measurements and is equal to the amount of kilocalories of heat energy a body generates in one day. A kilocalorie or kcal is equal to 1,000 calories. A calorie is the amount of heat needed to raise the temperature of 1 milliliter of water 1 degree Celsius. A detailed explanation of calories and kcal is found in the background of the extension.

Once the BMR is determined for an individual, another calculation is made to determine actual energy needs based on daily activity level. On a day of heavy exercise, the body requires more energy than on a day of rest.

Investigation Part One: How much energy does an astronaut need?

Materials per student team:

Mars Mission Astronaut Energy Needs work sheets

Calculators

Procedures:

1. Hold a discussion about human energy needs. Why do we need food? When are you hungriest? What happens to people who have too little food to eat? What happens to people who have too much food to eat? Since it may take up to two years for a round-trip visit to Mars, what ideas do you have to provide food, clean drinking water, and oxygen for the travelers?
2. Explain that a space mission to Mars will require a lot of food for the astronauts. How much food to pack for the mission will be determined by how many astronauts are going and how much food each of them needs.
3. Organize your students into small teams of three or four (use the same teams for each part of this activity).
4. Distribute the Mars Mission Astronaut Energy Needs worksheets. Teams will determine the energy needs for two typical astronauts (one male and one female).
5. Tell students that all measurements of mass and height are in metric units (kilograms and centimeters). Review the relationship of metric units to standard units. (1 kilogram = 2.2 pounds, 2.54 centimeters = 1 inch)
6. Discuss the mathematical operations needed to determine BMR. Remind them that they should first have to multiply the factors within the three parentheses before adding all the numbers together.
7. The answers for the two examples will be in

kcal or kilocalories. Discuss what a kcal is.

8. Have teams calculate Daily Energy Needs Based on Activity by multiplying the BMR for the two astronauts by the exercise factor. This operation will determine the approximate actual number of calories needed for a day based on the level of activity.

Tip: Have teams round off the BMR numbers before calculating daily energy needs.

Note: The calculated BMRs and Daily Energy Needs for each astronaut will be used in a later activity.

Assessment:

- Have teams report their results. All teams should arrive at the same answers. Identify teams that are having problems with the calculations and assist them to become proficient in their calculations.
  BMR for male astronaut = 2538.17 kcal
  BMR for female astronaut = 1668.09 kcal
- Have students discuss and explain why the “exercise factor” is necessary to determine daily energy needs.

Extensions:

- Suggest students calculate their own BMR and kilocalorie needs at home using the equations on the worksheets.

Mars Mission Astronaut Energy Needs

Student Names:

______________________________ ______________________________

______________________________ ______________________________

Part One

Instructions: Working as a team, determine the energy needs of a male and a female astronaut on a mission to Mars.

- Determine each astronaut's basal metabolic rate or BMR. (This is an estimate of how much heat energy is produced by their bodies. The energy comes from the food they eat; the action of their muscles and other body organs releases the energy as heat.)
- Determine the number of kilocalories (kcal) of food energy the two astronauts need each day to maintain their mass and fitness. (You will need the results of these calculations later when you will plan day menus for a Mars mission.)

BMR for a Male Astronaut

Age: 45 Height: 183 cm Mass: 91 kilograms

Male Astronaut Equation : BMR = 66.5 + (13.75 x mass) + (5.003 x height) + (6.775 x age)

To solve this equation, first calculate the values inside the three sets of parentheses. For example, the first set of parentheses is the product of 13.75 times the mass. The astronaut's mass is 91 kilograms.

Multiply 13.75 *times* 91

Do the same for the parentheses for height and age. Then, the answer for BMR is easy. Just add up the four numbers.

BMR = 66.5 + (13.75 x 91) + (5.003 x 183) + (6.775 x 45)

Calculations:

13.75 x 91 = ____________________

5.003 x 183 = ____________________ Place these answers in the equation below.

6.775 x 45 = ____________________

BMR = 66.5 +___________ + ___________ + ___________

BMR = ______________ kcal

Instructions: The BMR provides an energy baseline for an individual but there is one more thing to consider. How active is the person? A person who is sedentary (watches lots of TV, plays computer games, and gets little exercise) needs much less energy than someone who does lots of exercise (jogging, weight lifting, sports, heavy labor).

- Calculate the kcal needs of the male astronaut on a day when he does little exercise compared to active days. Multiply the BMR by the numbers below.

Daily Energy Needs Based on Activity

BMR x exercise factor = actual kcal needs

No exercise (TV, computer games, sitting) ________ x 1.2 = __________kcal

Moderate exercise (workouts, sports 3-5 days a week) ________ x 1.55 = __________kcal

Very active (hard exercise, heavy work) ________ x 1.9 = __________kcal

★ Eating more food than needed means excess calories will be stored in the body as fat, and body health will begin to deteriorate if this continues.

Instructions: Repeat the calculations for a female astronaut.

BMR for a Female Astronaut

Age: 42 Height: 157 cm Mass: 55 kilograms

Female Astronaut Equation: BMR = 655.1 + (9.5663 x mass) + (1.85 x height) + 4.676 x age)
(The numbers are different for females.)

BMR = 655.1 +___________ + ___________ + ___________

BMR = ______________ kcal

Daily Energy Needs Based on Activity

No exercise (TV, computer games, sitting) ________ x 1.2 = __________kcal

Moderate exercise (workouts, sports 3-5 days a week) ________ x 1.55 = __________kcal

Very active (hard exercise, heavy work) ________ x 1.9 = __________kcal

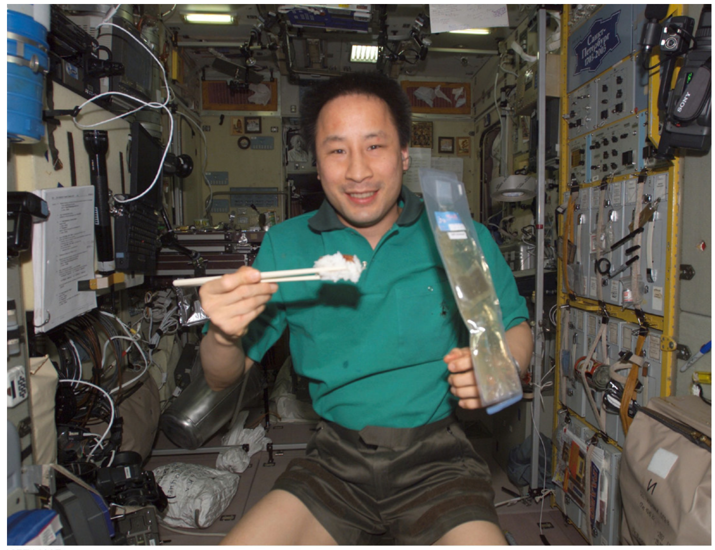
More Background

For a time, astronaut Shannon W. Lucid held the American space record for continuous number of days in orbit. Partly on the space shuttle and then on the Russian space station Mir, Shannon spent a total of 188 days in space before coming home. It was an amazing time for her, but also a lonely time. She missed her family and friends back on Earth. Periodically, robot spacecraft docked with Mir and brought fresh supplies including packages for Shannon. She eagerly awaited delivery of M&Ms and potato chips and one really special item - Jello in small serving cups. Shannon introduced her fellow Mir crew members to the taste of Jello. They were soon hooked. Sharing the treat helped bond the crew together. Shannon's crew members wanted the Jello so often that she finally had to ration the Jello cups and only serve them on Sunday nights.

Astronauts and cosmonauts in space are like everyone else. They miss their homes on long space missions. One way to keep their spirits up is to have good food at meal times.

Space meals have to be good tasting and provide enough energy and nutrients to maintain good health. NASA has an extensive list of tested foods that meet the requirements for space flight. Three-meals-a-day menus are picked from this list along with snacks and extra beverages. The meals are decided upon before launching into space. NASA astronauts spend time taste testing foods and planning their menus; NASA food scientists double-check the menus to make sure they provide the needed calories and nutrients.

Astronauts have lots to say about what the meals include but dieticians have to approve the selections. Special items, such as foreign, regional, and ethnic items are sometimes included for astronauts and cosmonauts of other countries. Of course, once in space, astronauts can swap out items from different meals to fulfill



)07E14837

U.S. Astronaut Edward Tsang Lu enjoys eating a meal on the International Space Station with chopsticks.

their cravings.

The crew for a future mission to Mars could include American, Canadian, Chinese, French, German, Japanese, and Russian crew members. Keeping everybody happy on a two-year mission will provide great challenges for space meal planners. In the next activity, you will be able create your own space food menu for a U.S. and an international astronaut or cosmonaut.

U.S. Astronaut Shannon W. Lucid inside the crowded Russian Mir Space Station.

Russian cosmonaut Yuri V. Usachev is surrounded by various canned Russian space foods on the International Space Station.

Investigation Part Two: Guess Who's Coming to Dinner

Materials per student team:

International Space Station Standard Menu Nutritional Data table
Menu Planning Sheets
Internet/school library access

Materials for the class:

International cookbooks

Procedures:

1. Review the first part of the investigation with your students. Make sure students understand BMR, daily energy needs, and kilocalories.
2. Distribute the Standard Menu Nutritional Data tables (Appendix A) to the teams. Go over what the table lists for each food item. The second column from the left provides abbreviations that describe the type of the food. A legend on the last page of the table explains the abbreviations. For convenience, they are:
   NF - Natural Form (e.g., almonds)
   B - Beverage
   T - Thermostabilized ("canned")
   R - Rehydratable (e.g., freeze-dried)
   I - Irradiated (e.g., meats exposed to radiation to kill bacteria)
   IM - Intermediate Moisture (e.g., dried apricots)
   FF - Fresh Food (e.g., bananas)
3. Challenge student teams to create a one-day menu (breakfast, lunch, snack, and dinner) for one of the two astronauts they used as examples when learning how to calculate BMR and daily energy needs. They should prepare the menu for the male or the female astronaut using the numbers they calculated.
4. Upon completion of team menus, have each team present their menus to the class in the form of a poster, spreadsheet, or PowerPoint display. Check to see if the menus provide the required number of kilocalories for the astronaut. Compare the menus to see which ones have the lowest launch mass. Discuss why this is important.
5. Challenge the teams to create a new one-day menu, using the same table, for an international crew member. Have them pick a male or female (using the same numbers as in step 3 and decide which nation the crew member is from. Have students choose from the following list and write the name of country on the menu:

Canada	China
France	Germany
Japan	Russia

6. When constructing the menu for the chosen crew member, teams should become familiar with foods and customs of the crew member's country. While the Standard Menu Nutritional Data table will still be used for menu construction, teams will have to look for items on the list that might appeal to the international crew member.
7. Review the team menus using the process described in step 4.

Assessment:

- Collect and review the menus of the teams.
- Shuffle the menus between the teams and have the teams write a review of the menu from another team and comment on its variety, balance, energy, etc.

Extensions:

- The United States Department of Agriculture (USDA) provides many classroom resources for diet and menu planning. Interactive resources permit students to research foods and evaluate menus appropriate for their ages. Have student teams evaluate their proposed menus by using the online interactive "My Plate" site from the USDA. Have students explore more about the history and processing of U.S. space food at the NASA website below.

Resources:

USDA "My Plate"
http://www.choosemyplate.gov/
http://www.choosemyplate.gov/tipsresources/printmaterials.html

Food for Space Flight: Space Food History
http://www.nasa.gov/audience/forstudents/postsecondary/features/F_Food_for_Space_Flight.html

Mars Mission Menu Planner

Student Names:

__________________________ __________________________

__________________________ __________________________

Instructions: Plan a one-day Mars mission menu for one of the two astronauts you used for calculating BMR and Daily Energy Needs.

- Select the male or female astronaut and begin filling out the menu on the next page.
- Using the International Space Station (ISS) Standard Menu Nutritional Data table (Appendix A), plan three meals and a snack for your astronaut for one day.
- When your menu is completed, analyze the menu you created using the questions below.

Menu Analysis

1. How many kilocalories does the total menu provide (add together the “kcal” for all items)?

____

2. How much protein in grams does the total menu provide (add together the “Pro” for all items)?

____

3. How many carbohydrates in grams does your menu provide (add together all the “CHO” for all items)?

____

4. How much fat in grams does your total menu provide (add together the “Fat” for all items)?

____

5. What is the mass of your total menu in grams (important to keep launch mass low)?

____

6. Write a paragraph describing the good points about your menu and explain why an astronaut should eat all the foods it includes. Include information about whether your menu meets the kilocalorie needs of your astronaut.

One-Day Menu - First Mission to Mars

Crew Member: Male ☐ Female ☐ Nationality: ____________________

BMR: ___________Kcal Daily Energy Need: ______________Kcal

Breakfast

Food Item	Kcal	Pro (g)	CHO (g)	Fat (g)	Mass (g)

Lunch

Snack

Dinner

Extension - Burning Question: Which Foods to Take To Mars?

Professional laboratory “bomb” calorimeter.
Source: http://en.wikipedia.org/wiki/Calorimeter

Background

How do we determine how much energy a food will provide? We burn it. More than 100 years ago, Wilbur O. Atwater, a nutritional chemist, invented a device that could be used for measuring the relationship between energy input (food) and heat output of a person doing exercise. His work inspired the development of the basal metabolism rate (BMR) measurements students explored in the first activity. Incidentally, Atwater concluded that Americans consumed too much fat and too many sweets. (Where have we heard that before?)

The determination of the energy content in food is determined by a device called a calorimeter. It measures the amount of heat given off by foods when they are burned. The food is placed inside the calorimeter and ignited. Heat is produced in units called calories.

Calorie - the amount of heat needed to raise 1 milliliter of water 1 degree Celsius. (In the metric system, a calorie is equal to 4.2 joules.)

When you read the nutritional label on a package of food, you will find a listing for the number of calories the food provides per serving. The labeling is in part based on Atwater’s work. However, not mentioned on the food label is the fact that the units are kilocalories (1,000 calories), but labeled as “Calories.” Presumably, this is done to make things look less scary. A 1/2 cup serving of ice cream might provide 160 calories. That’s actually 160 kilocalories or 160,000 calories! (You don’t want to know what’s in the whole pint.)

Back to Mars. Mission planners will determine the kilocalorie needs of the crew (about 3,000 for males per day and 2,400 for females per day). Then, they calculate the mission needs. The equation will be something like this.

M = number of males
F = number of females
D = days in flight

$$[(M \times 3{,}000) + (F \times 2{,}400)] \times D = \text{number kilocalories}$$

Figuring things out gets harder. Every food type provides different amounts of energy and has different mass and takes up different amounts of space. Then, the dietary nutrients need to be considered. Food provides more than just energy - fats, sugars, proteins, minerals, etc. (You can’t take only chocolate bars even if they have nuts!) The last part gets really tough. Food choices have to be those that each astronaut will actually like and eat!

In this extension, students construct a simple calorimeter and use it to determine the energy content (calories) of several small bits of food.

Safety Note - Flames:
This activity involves flames and should only be conducted in a well-ventilated area, preferably a science laboratory. Be sure to follow basic fire safety precautions and discuss these with the students beforehand.

- All students should wear safety goggles and avoid breathing any smoke produced. (The calorimeter design confines the flame in a small chamber.)
- When teams have completed their setup for a run, ignite the food item for them.

Investigation: Burning Question - Which Foods to Take to Mars?

Materials: per student team

Two pot pie tins
Copper or aluminum wire (non-coated) approximately 45 cm long
Two small metal binder clips
Soft drink can (top removed by using a can opener – teacher prepared)
Beam balance (teams can take turns using it)
Thermometer - Celsius scale
Graduated cylinder
Water 50 ml per test
Ruler
Scissors
Safety goggles

Teacher - Butane lighter (long nozzle)

Food items: three food items from the categories below per student team

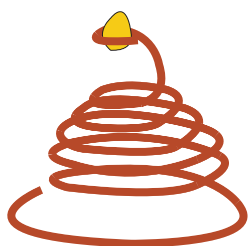
Categories
Peanuts - dry roasted, cocktail, and raw
Other Nuts - pecan and walnut
Dried Beans - navy, pinto, lima
Misc. Foods - Cheerios®, stale miniature marshmallows

> **Allergy Alert:**
> The food item categories include peanuts and other nuts. If you have students with nut allergies, use the other suggested items such as beans, cereal, etc.

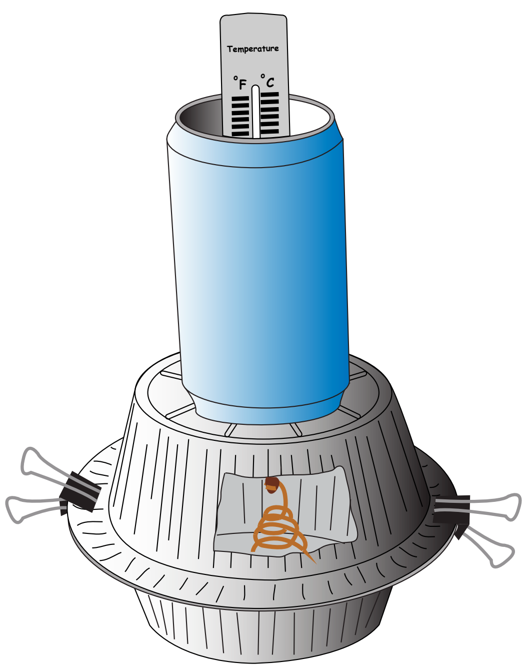
Procedures:

1. Divide students into teams of three.
2. Before beginning the activity, discuss safety procedures with the student teams. While students will not be lighting the food items, there will be small flames and a small amount of smoke. All students must wear eye protection and avoid breathing the smoke.
3. Have teams cut a hole in the top of one pot pie tin. The hole should be smaller than the soft drink can bottom. Teams will cut a circular or rectangular viewing window from the side of the same pot pie tin. See diagram on Page 12.
4. Have students bend the wire into a stand for holding the food item. See diagram. Wrapping the wire around an object such as a small funnel or large marker will help form the stand.
5. Have students weigh their three food items using the beam balance so that all three are the same. If an item is heavier than the others, teams should break off a small amount of the item. Tip: Use half peanuts rather than whole to reduce the burning time and still give excellent data.
6. Before igniting the food, students should secure the food item to the top of the wire by simply pressing the wire around the item.
7. Be sure to explain to the students the importance of having each item the same distance from the can when burning. This can be accomplished by measuring the height of the coil before each test.
8. The students will place the stand and food item in the middle of the lower pot pie tin. Gently place the cut tin on top. Clamp the top and bottom together with the binder clips. See diagram on page 12.
9. Have students measure 50 ml of water and pour it into the can. Have them measure and record the initial temperature before starting the next part of the experiment. This step is repeated for each item burnt.
10. Students will gently place the cola can with the thermometer inside on top of the pot pie tin, covering the hole.
11. Once the apparatus is ready, ignite the food items for each team. Students should observe the burning. When the flame goes out, they measure and record the water temperature.
12. The water should be replaced and steps 6-11 should be repeated for the next two items. The bottom of the can gets covered in soot, so have students avoid touching the bottom if possible to avoid getting soot on their hands and clothes. Also have students wait 5 minutes because the top part of the wire stand will be hot.

Calorimeter setup. The round hole in the top tin is smaller than the diameter of the soft drink can bottom. The window cut through the top tin allows for lighting the food and for observation. Binder clips hold the calorimeter together.



Bend the wire to form a conical spring. Wrapping around something circular will help form the shape. Foods to be tested are held by bending the wire at the top around them.



Fully assembled and ready.

Assessment:

- Review the data and the answers to the questions on the student pages.
- Have students discuss the importance of sending energy-packed foods on a Mars mission.
- Ask students to define calorie and kilocalorie.
- Have students write about the challenges of providing food for extended space missions and propose ideas for meeting those challenges.

Extensions:

- Show the nutritional labels of several food products and explain how to read the labels. Discuss the relationship between serving size and calories. Discuss the other numbers on the label and what they mean (e.g., fat calories, sodium, sugar, etc.). Information on reading food labels can be found at the following sites:

  http://www.fda.gov/Food/LabelingNutrition/ConsumerInformation/ucm078889.htm

- In addition to selecting high-energy foods for space missions, discuss other space food issues. How long will the food keep? (Raisins and nuts keep a long time but bananas start spoiling in a few days and the peel will release odors. However, dried banana slices will keep a long time.) How will the food be packaged? How much storage space will the food packages take and how much waste will be generated? (Demonstrate the volume of a cereal box versus the actual volume of cereal.)
- Have students experience the challenge of selecting food for a space mission by asking them to determine how much food they could fit into a standard-sized shoebox. Ask them to determine the combined nutritional value of the foods and estimate how many people it would feed for how many days.

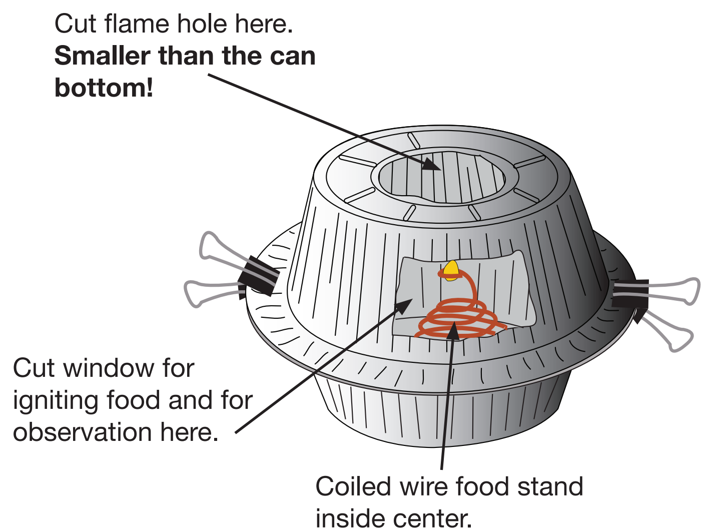
Burning Question: Which Foods to Take To Mars?

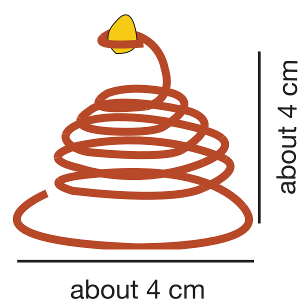
Directions: Constructing your calorimeter. Refer to the diagrams at right on how to construct and set up your calorimeter.

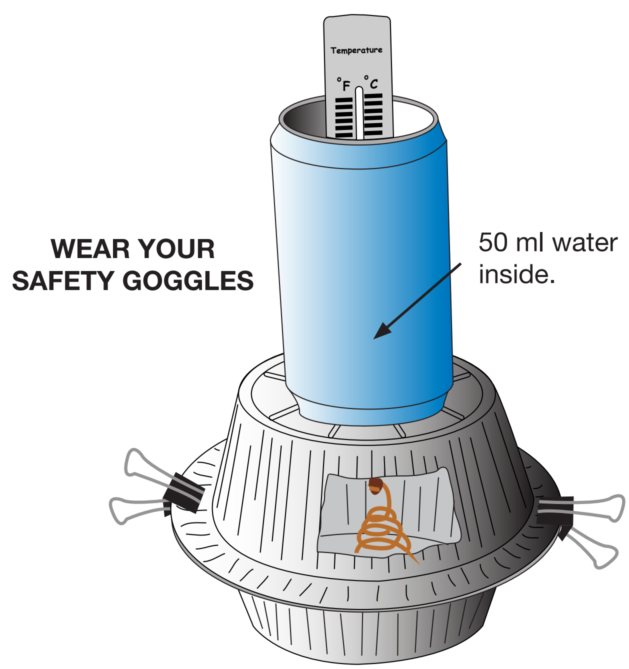
1. Cut a 4-cm diameter hole through the bottom of one pot pie tin.
2. Cut an observation window in the side of the same pot pie tin. Do not cut the lower tin.
3. Coil the wire to make a food stand.

Directions: Using your calorimeter

1. Measure the mass of your three food items. Pinch or cut off small pieces until all three have the same mass. Record the mass on the data table.
2. Attach the first food item to the top of your stand by pressing the wire around the food to hold it securely.
3. Measure and record the height of the stand and food item. Adjust the stand so that the height is the same for each test.
4. Place the coil in the center of the lower tin and cover with the top tin.
5. Carefully clip the tins together as shown.
6. Measure 50 ml of water and pour it into the can. Measure and record its temperature.
7. Gently place the can with the thermometer over the center hole.
8. Raise your hand to let your teacher know you are ready to light the food.
9. Observe the burn. (Safety Goggles.) When the flame goes out, measure and record the water temperature again.
10. Pour out the water and repeat steps 2-9 for the next two food items. Be sure your coil remains the same height.







Calorimeter ready for first test.

Burning Question: Which Foods to Take To Mars?

Student Names:

____

____

____

> Calorie - The amount of heat energy needed to raise 1 milliliter of water 1 degree Celsius.
>
> Kilocalorie = 1,000 calories

Determining how many calories each food item contains.

1. Calculate the difference between the initial and final water temperature for each food item.

2. Multiply the temperature difference for each item by 50. This gives the number of calories each item contains.

	Mass of Food Item	Initial Water Temperature	Final Water Temperature	Temperature Difference	Number of Calories
Food Item #1 __________					
Food Item #2 __________					
Food Item #3 __________					

Which food item will be the best choice for packing energy for a mission to Mars?

Why is it important that the food items be supported at the same distance from the can?

Explain why you had to multiply your answer by 50.

Always Wash Your End Effectors!

Quick Look

Student teams will construct robots to perform a simulated food handling task on a future mission to the planet Mars. After demonstrating their designs, teams will be presented with a surprise challenge. They will check their robots for microbes using sterile culture plates.

Objectives

- Design and assemble a robot to perform a specific task using commercial robot kits or construct a simulated robot using various scrap materials.
- Demonstrate the robot in a simulated food handling activity.
- Sample and analyze the surfaces of the robot for possible microbe contamination using sterile cultures.

Background

You've heard about the importance of washing your hands, but washing your end effectors? What's that about? Actually, it's pretty much the same thing. An end effector is the robot term for hand.

Why is it important to keep the end effector clean? The answer is microbes. A microbe is an organism consisting of a single cell or of a small cluster of cells. Microbes are usually too small to be seen with the naked eye. Microbes include bacteria, fungi, protists (protozoa, algae), and viruses.

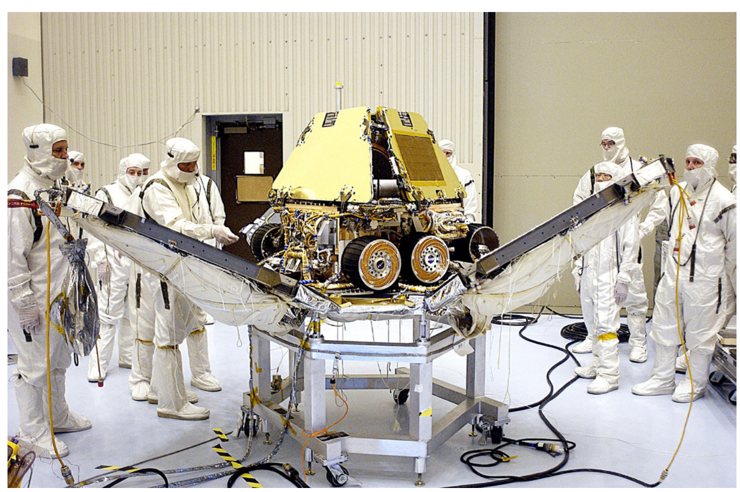
There are far more microbes on planet Earth than all the other life forms put together. Take you, for example. There are more microbes living inside your body and on your skin than you have cells in your body. These microbes help digest our food, protect us from disease, and a whole bunch of other necessary processes that keep our bodies functioning and healthy. We use microbes to make cheese and yogurt, and microbes cause bread to rise. On a planet scale, microbes produce most of the oxygen we need and recycle dead animal and plant matter.

Microbes are a powerful force on Earth. But then, there is the dark side of the force. There are nasty microbes responsible for diseases like malaria, cholera, influenza, colds, and so on. That's where we get back to washing end effectors. Robots are used in a big way to process the food we eat. For example, you don't think a bunch of people are lined up with funnels putting ketchup into bottles! Robots do the job. They squirt the ketchup in the bottles, attach the safety seal, screw on the cap, stick on the label, and load the bottles in the cartons. Those robots have to be super clean, or the ketchup could be infected with bad microbes.

When it comes to space food, being super clean is important. If an astronaut on the way to Mars gets sick from a spoiled can of tuna, a trip to the emergency room is out of the question.

There is another reason for being super clean when exploring space. NASA has sent many robot spacecraft to the surface of Mars to try to answer the question, "Is there life on Mars?" There have been lots of discoveries that hint that life on Mars is possible but no actual life has been found yet. Wouldn't it be terrible if life is discovered on Mars and it turns out to be microbes that hitched a ride from Earth?

To prevent infecting Mars with Earth microbes, technicians at NASA go to great



Technicians preparing the Mars Opportunity Rover in a clean room. Every care is taken to avoid contaminating the robot with stray objects or microbes.

lengths to sterilize robots and encase them in a protective shell to keep hitchhikers out!

We learned about one possible strategy for future Mars missions in the "Mars Needs Food!" activity: Send robots to Mars to grow and store oodles of food in preparation for the arrival of the astronauts. Making sure the food is not contaminated by harmful microbes is also essential.

Materials

- Robot kits for each team (LEGO® MINDSTORMS®, VEX® Robotic Design System, LEGO® Education TETRIX®, LEGO® WeDo™ etc.)
- Various scrap materials (if robotic kits are not available) such as
  - Cardboard tubes
  - Empty water bottles
  - Dowels
  - PVC pipe parts
  - Plastic food containers
  - Aluminum foil
  - Binder clips
  - Rubber bands
- Prepared "culture plates" - petri dishes with agar or baking potato slices and zip locking sandwich bags. See note about preparing culture plates.
- Cotton swabs (place two in a plastic bag to make distribution easier and reduce the chance of contaminating them) or packaged sterile swabs.
- Distilled water
- Bleach solution (about 10% bleach, 90% water)
- Latex, latex-free or vinyl exam gloves
- Disposable face masks

Preparing culture plates

The second part of this activity involves the search for microbes. As students assemble and program their robots or create model robots, they will naturally handle, breathe, cough, and sneeze on them. In doing so, they will deposit microbes on their surfaces. It is for a similar reason that many stores place wipes for customers to clean the handles of shopping carts.

Using sterile procedures (described later) students will swab the surfaces of their creations and transfer some of the microbes to a growth medium. The growth medium will either be agar, a seaweed product, or slices of potato. If using agar, ready-to-use plates are available from school science suppliers. If desired, bottled agar and petri dishes can be purchased separately. If doing so, follow the instructions for preparing the plates.

A low-cost alternative to agar plates is 1/4- to 3/8-inch-thick slices of potatoes that have been boiled until nearly cooked. Boiling sterilizes the potatoes. Using a sterile knife, slice the potatoes. Ideally, the slices can be placed in petri dishes instead of agar. The dishes have lids that make them very convenient to use. Otherwise, the slices are placed in zip locking sandwich bags after being inoculated.

It is essential not to touch the slices (or the surface of agar) or breathe on them. Have the petri dishes or potatoes ready on the day the robots are completed. It is not necessary to have an incubator. The culture plates will do just fine at room temperature.

Special Note: Careful handling of the culture plates is important. The object is to capture microbes that have taken up residence on the outside of the robots student teams construct. Once enclosed, the agar or potato slices should not be opened to avoid adding new microbes. When the activity is completed, the cultures should be disposed of. Traditionally, laboratories will use a disinfecting agent to destroy the cultures. If you wish to follow proper lab procedures, pour a bleach solution into each petri dish or sandwich bag, reseal, and dispose in a tied plastic garbage bag.

Procedure - Building robots

1. Hold a class discussion on how a future human mission to Mars might be preceded by robots that set up greenhouses, grow food, and prepare for the arrival of astronauts.
   - A human mission to Mars could take two years.
   - How much food and water will a crew of six or more need? (See discussion in the

"Mars Needs Food!" activity.)
- Discuss the care NASA takes to prevent sending microbes to Mars and other worlds, and the diligence that it takes to ensure astronaut food is safe. Explain what microbes are and ask, "Are your robots carrying microbes?"

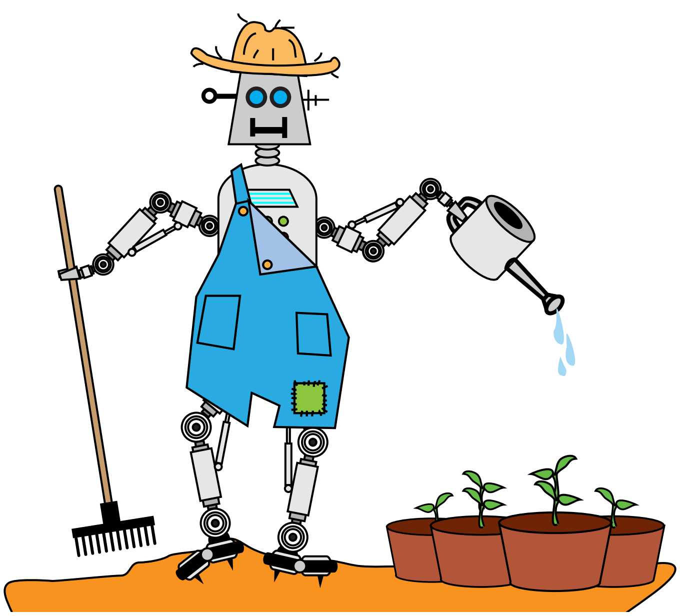
2. Challenge teams of students to design a robot to perform a food-growing or food-preparation task that could be done on Mars.

Possible Robot Challenges
Have student teams determine what particular food production task their robot is designed to perform. The following are just a few ideas to spark the imagination:
- Seed planting robot
- Irrigation robot
- Harvesting robot
- Crop transport (to storage) robot
- Cooking pot stirring robot
- Water glass filling robot

It is not necessary to work with actual food when teams demonstrate their robots. For example, a CD can be used as a simulated pancake for a pancake flipping robot.

Check these sites for additional ideas:
http://robotics.nasa.gov/archive/robot_news.php

http://www-robotics.jpl.nasa.gov



A factory robot puts bread onto pallets. Image © 2011 by KUKA Robotics Corporation. Used with permission.

Teams should begin by selecting a particular task for the robot. See the list of Possible Robot Challenges for ideas. The robot should do one task well.

3. If students are already familiar with the robot kits you have available, turn them loose. Otherwise, have the teams work with the robots for a class period or two to learn their capabilities. Then, turn them loose. Or, have students construct a model robot from the scrap materials available and other materials students might bring from home. While their robots will be unpowered, parts such as arms and end effectors (grippers) should be movable.
4. When all robots or robot models are ready, hold an exposition for the class and have each team explain the purpose of their robot and demonstrate how well it completes its task.

Procedure - Checking for microbes

1. Discuss the care NASA takes to prevent sending microbes to Mars and other worlds. Explain what microbes are and ask, "Are your robots carrying microbes?"
2. Have student teams swab the surface of their robots in several places with cotton swabs and use the swabs to inoculate the culture plates.
3. Observe the culture plates daily for a week or two.
4. When plates begin showing colonies of microbes, hold a class discussion on possible strategies to keep Mars robots sterile.
   - Hand washing

- Plastic gloves
- Face masks
- Wiping robot with disinfectant

5. While testing for microbes, prepare additional plates that will not be inoculated to use as experiment controls.

Assessment

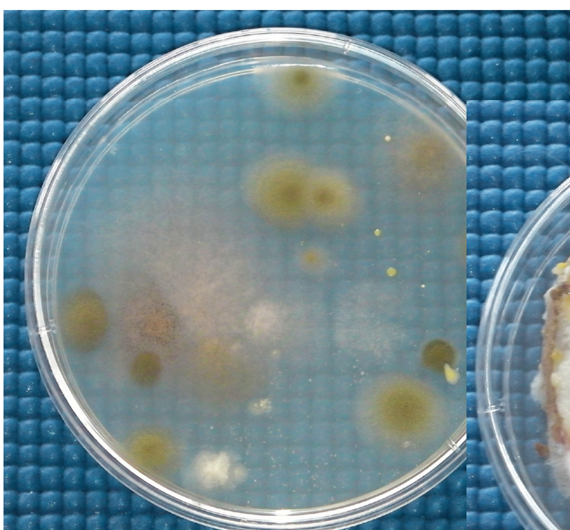
- Review student team presentations about their robots and how successful the robots are at performing their tasks.
- Have students write a step-by-step procedure for ensuring robots destined to Mars and other worlds are sterile. Have them take apart and reassemble their robot using sterile procedures. First, have teams sterilize the components with disinfectant wipes. Teams should wear disposable gloves and paper face masks. When the robots have been reassembled, have students repeat the swab and culture plate test. Are the results the same or different?

Extensions

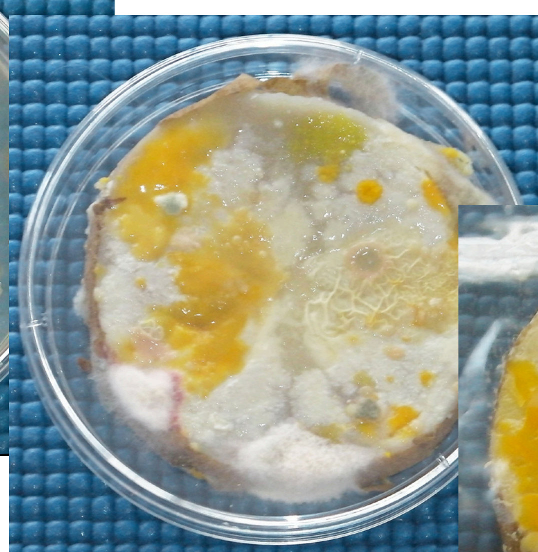
- Learn about microbes on Earth. How do microbes help us? What diseases are caused by microbes?
- Investigate how we learn about microbes. What kind of microscopes are used to learn about bacteria and viruses?
- Discuss other applications for sterile procedures (food production, hospitals, dentists, etc.).
- Learn about NASA food labs and clean rooms at the following sites:
  http://www.nasa.gov/centers/johnson/slsd/about/divisions/hefd/facilities/space-food.html

  http://www.nasa.gov/mission_pages/msl/building_curiosity.html

Sample Microbial Cultures



Keyboards - bacteria and fungus



Kitchen sink - bacteria and fungus

Skin swab

Design and Build a Mars Food Production Robot

Student Names:

______________________________ ______________________________

______________________________ ______________________________

Task your robot will perform: ____

____

Name your robot: ____

Preliminary Sketch of Your Robot

Describe how your robot will work: ______________________________________

____

____

____

____

____

What ways can you change your robot to improve it? ____________________________

____

____

Sampling Your Robot for Microbes

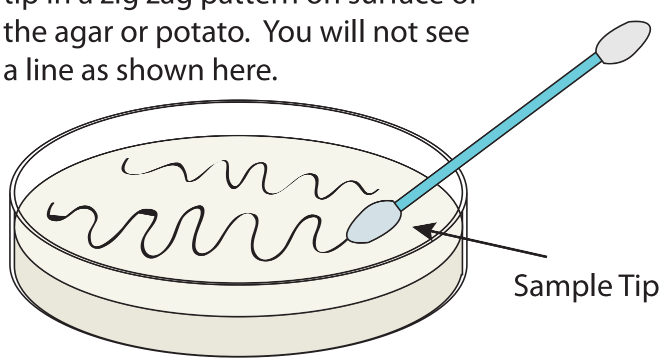
Steps

1. Carefully read and follow all directions in order to swab and culture microorganisms from the surface of your robot. Be sure to review the diagram below before inoculating your culture plate or potato.
2. Pick several areas on your robot for sample taking that you and your team touched during assembly.
3. Carefully remove one swab from the plastic bag. Only handle one end of the swab. If you accidentally touch both ends, dispose of the swab and use another.
4. Lightly moisten the sample tip of the swab with distilled water.
5. Rub the tip over the areas you chose for sampling.
6. Immediately rub the same tip in a zigzag pattern over the agar or potato surface.
7. Cover the agar or potato and mark the cultured plate to identify it and the places sampled on your robot.
8. Set the plate in the designated place and examine it every day for a week or two.* Create a log book for your written observations and sketches (see example). At the end, write a summary of what happened.

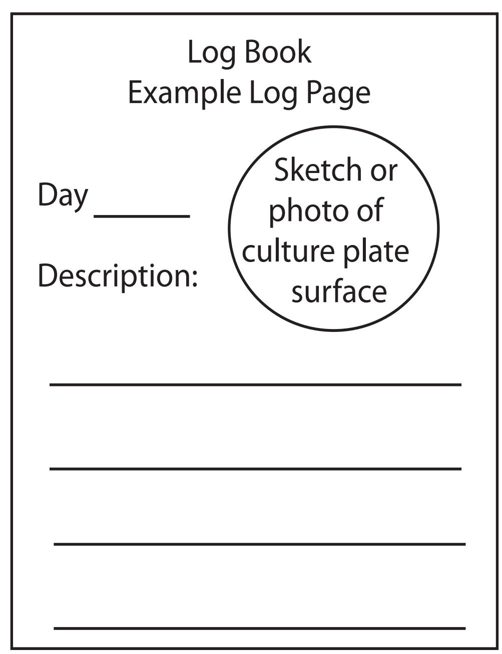
* Note about using petri dishes: To avoid condensation dripping on to the agar surface, turn the plates upside down. Use a rubber band to secure the lid.

Innoculating a Culture Plate

After collecting samples from your robot, lightly rub the sample tip in a zig zag pattern on surface of the agar or potato. You will not see a line as shown here.



Do not touch or breathe on the swab sample tip or on the culture plate!



Now That's a Cup of Coffee!

Quick Look

Just like people on Earth, astronauts in space need food to keep up their energy and get the job done. In this collection of demonstrations and activities, students will learn about some of the properties of liquids (a main component of many foods) and how technology helps astronauts get food and beverages to their mouths and not all over themselves, in their noses and ears, or on space station walls.

Objectives

- Students will investigate adhesion, cohesion, contact angle, and capillary action in liquids.
- Students will design and test a new and improved microgravity coffee cup for making mealtime in space easier and more enjoyable for astronauts.

Background

In 1962, John H. Glenn Jr. became the first American to orbit Earth. During his nearly 5-hour-long space mission, Glenn sampled a bit of food. Food wasn't necessary for such a short flight but it gave him a chance to test food technology that would be needed later. Glenn sucked on some applesauce from a small roll-up toothpaste-like tube. In spite of worries that astronauts in microgravity might have trouble swallowing, Glenn easily downed his snack. It tasted fine, just like applesauce was supposed to taste, but the roll-up tube dispenser was awkward and unpleasant to use.

As space missions stretched into days and weeks, food and beverages became essential. The applesauce toothpaste tube was just the start of many space food inventions. While swallowing was no longer considered a problem, getting the food to astronaut mouths was a terrifying thought to spacecraft engineers.

"What if liquids get loose and short out electrical equipment?"

"What if food particles clog air filters?"

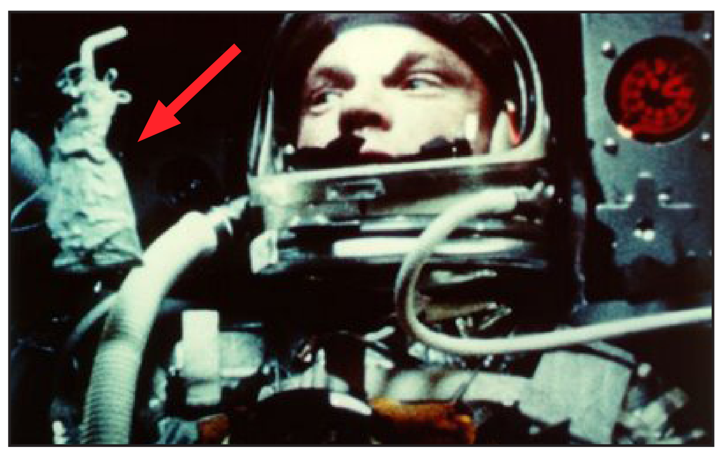
"What if crumbs go up astronaut noses?"

"What if food starts rotting?"

There were lots of "what ifs." It became obvious that "food safety" in space meant more than just keeping astronauts healthy. It was also about keeping the spacecraft healthy. It was up to dieticians and engineers to create safe space food systems. Here are some of their more memorable inventions:

Astronaut Hall of Fame of Space Food Inventions

Gelatin-coated sandwich and cookie cubes
Telescoping drink bottles
Liquid salt and pepper
Compressed bacon squares
Dried green pea and spinach bars
Freeze dried ice cream



The applesauce tube (upper left) drifts by John Glenn during his Mercury mission.

Actually, none of these great inventions were popular with the astronauts. Some, like the astronaut ice cream, flew in space only once.

Big changes in space food technology came when food engineers realized that moist food is sticky! Dip a spoon into a pudding pack and out comes a spoonful of pudding. Turn the spoon upside down and the pudding clings to the bowl of the spoon. (Important tip: Don't do this with chocolate pudding while wearing white AND DON'T SHAKE THE SPOON!)

In microgravity, pudding sticks to the spoon better than on Earth. In other words, knives, forks, and spoons work in space. You can have mac and cheese, soup, stew, and a whole bunch of other foods in space. And, for the crumbly stuff like bread, no more gelatin coating (yuck). Substitute tortillas. Tortilla peanut butter and jelly roll ups are delicious!

Early space food packages - "tubes and cubes."

Today's astronauts are pretty happy with space foods. But don't get the idea that everything has been invented that could be invented. For example, beverage containers need some work. Your typical space beverage container is a flat foil-coated plastic bag. The dry flavoring crystals are already inside. Add some cold or hot water, mush it up with your fingers to dissolve the crystals, and drink through a straw. While the bags work, having a cup of hot coffee, cocoa, or tea through a straw is not all that good. Wouldn't a steaming mug of coffee be great?

Astronaut Donald Pettit thought so when he was on the International Space Station. He invented a microgravity coffee cup. He cut a plastic sheet, like those used for overhead projectors, and taped it together to form a cup. From the top, the cup looked like a teardrop. Pettit added coffee to the cup and then pinched the V-shaped edge. Coffee rose from the bottom

Astronaut Donald Pettit sips a microgravity cup of coffee with his invention.

of the cup to the cup's lip and Pettit sucked in the coffee. "Ahhh! That's a cup of coffee."

How did the cup work? The answer is contact angle. Liquids always meet clean, smooth solid surfaces in a definite angle that scientists call the contact angle. Pinching the V-shape of the cup increased the contact angle so that the coffee traveled from the bottom of the cup to the lip. The best way to understand why this happens is to do the following demonstrations.

Demonstrations: Using The Properties of Liquids to Defy Gravity

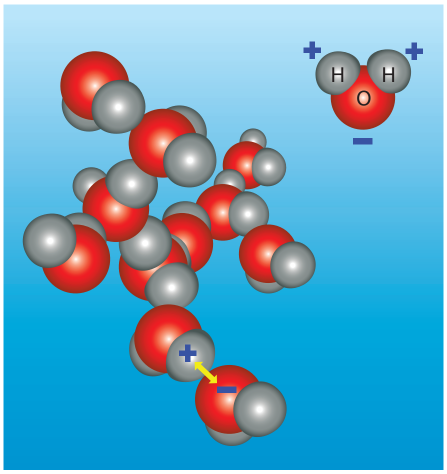
Together, the following demonstrations explain how Donald Pettit was able to drink coffee from his cup while in space. They will also prepare students for inventing new space food technology devices. First, a few terms need to be defined.

Adhesion - A force (IM) between molecules of water and a surface, like glass. For example, adhesion causes tiny water drops to cling to the outside of a window during a light rain.

Capillary Action - Rising of water in very thin tubes and closely spaced surfaces due to cohesion and adhesion. Capillary action opposes gravity. At some point, the weight of the rising water is too great to go further.

Cohesion - A force between the molecules of water (intermolecular force or IM) that make them stay close together. Check out the water molecule diagram for more information.

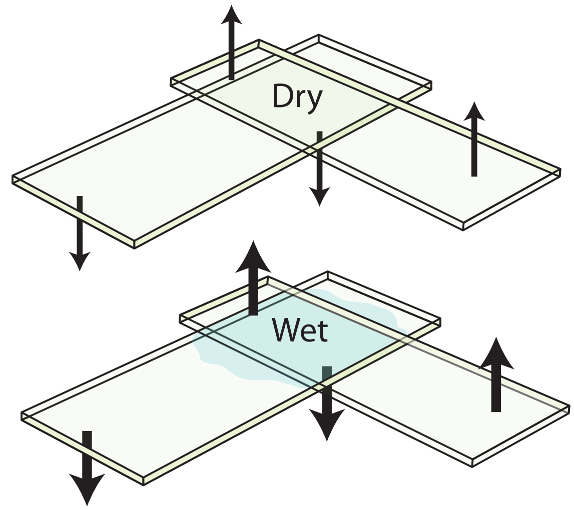
Contact Angle - The angle at which water (and other liquids) meet clean, smooth, and solid surfaces.



A Bit About Water
Water consists of two atoms of hydrogen bonded with one atom of oxygen. Their arrangement resembles the head of Mickey Mouse. The oxygen atom has a net negative electric charge and the hydrogen atoms have net positive electric charges. Because of this, water is a polar molecule that attracts other water molecules. The oxygen or negative side of the molecule attracts one of the positive hydrogen atoms of another water molecule. The polar nature of water enhances its cohesive properties, pulling molecules toward each other, creating the form of the water drop. In microgravity, where gravity forces are greatly reduced by free fall, water forms beautiful large spheres.
For videos of water in microgravity, go to the following site:
http://spaceflightsystems.grc.nasa.gov/WaterBalloon/#ISS

Adhesion Demonstration

Materials: 2 clean microscope slides, student-grade, 1.0-1.2 mm



1. Place two clean glass microscope slides together at a 90-degree angle. Pull them apart (straight up and down) and feel the force necessary to separate them.
2. Repeat, but this time place a drop of water between the slides. Again, pull them apart and feel the force necessary to separate them. Is there a difference?

What's Happening?
There is a significant difference between pulling apart two dry glass slides and two slides with a drop of water between them. The intermolecular force (IM) or adhesion of the water makes it harder to pull apart the two glass slides it is clinging to.

Cohesion Demonstration

Materials: Wax paper
Water drops

1. Flatten a piece of wax paper on a tabletop.
2. Sprinkle water drops on the paper.
3. Look at the shapes of the drops. How do large and small drops compare to each other?

What's Happening?
The IM force draws water molecules together to form drops. Certain materials, like wax in wax paper, reduce the ability of the water to adhere to the paper. Instead, the drops take on a spherical shape. Big drops have more weight and gravity causes them to flatten somewhat.

Note: All demonstrations may also be set up as learning centers or hands-on activities.

Capillary Action Demonstration

Materials: Paper towel
Scissors
Glass of water
Food coloring

1. Cut a 1-inch-wide strip of paper towel.
2. Hold the strip vertically and dip its lower edge into a glass of water that has food coloring added.
3. Watch what happens to the water.

What's Happening?
The water climbs into the towel in the spaces between and inside the fibers. Both cohesion and adhesion are at work here. Adhesion causes the water molecules to climb into the fibers and cohesion pulls more water molecules from below (kind of like a chain of molecules). Eventually, the water reaches a level where its weight is too great and gravity stops further climbing.

Investigation: The Best "Antigravity" Wedge Angle

Materials: Shallow dish of water (e.g., petri dish)
Food coloring
2 clean glass slides
Tape
Paper protractor

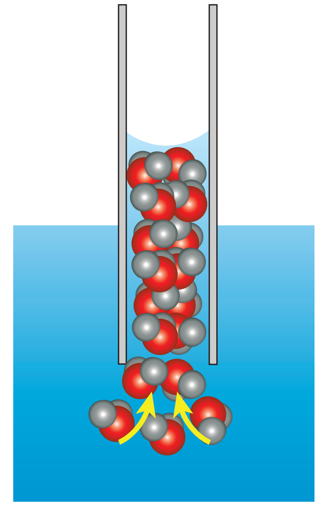
(Note: The following two pages are to be given to student teams; you may laminate the protractors and reuse if desired.)

Procedure:

1. Have small teams of students affix a piece of tape along the upper half of the long side of two clean glass slides to make hinges. Caution them to be careful handling the slides as they break easily.
2. If using petri dishes, have teams place one paper protractor beneath each dish to serve as a guide on determining the angle of the slides.
3. Add food coloring to the water in the dish to make it easier to see.
4. Show students how to stand the slides upright in the water (tape upwards) and spread the slides apart to form a V-shape (see page 26).

A Bit About Capillary Action

Adhesion and cohesion work together to raise water up a capillary (narrow tube). Adhesion attracts the water molecules to the glass tube, causing them to cling to the sides of the tube, while cohesion pulls more water molecules from below.



5. Have students examine the contact angle of the water to the slides (the way the water rises up between the slides). To do so, the students must observe the water from the side at tabletop level.
6. Have students change the wedge angle of the slides and observe how the contact angles change. (Spread them farther apart and bring them closer together.)
7. Discuss student observations and ask for thoughts on the relationship of the angular separation of the slides and the contact angle of the water.

What's Happening

The water molecules are attracted to the glass slides because of the IM forces (adhesion). Molecules move up between the slides and pull more water behind (cohesion). The climb of the water between the slides is called capillary action. The closer the slides are to each other, the higher the water can climb. The contact angle becomes steeper and steeper. Eventually, the weight of the water prevents it from climbing any higher. However, in microgravity, water can continue climbing. This is why Donald Pettit's coffee cup worked on the International Space Station.

Microgravity Coffee Cup Video

To see a video of the space coffee cup in action and hear Donald Pettit's description, go to the following site:
http://spaceflight.nasa.gov/gallery/video/shuttle/sts-126/html/fd10.html

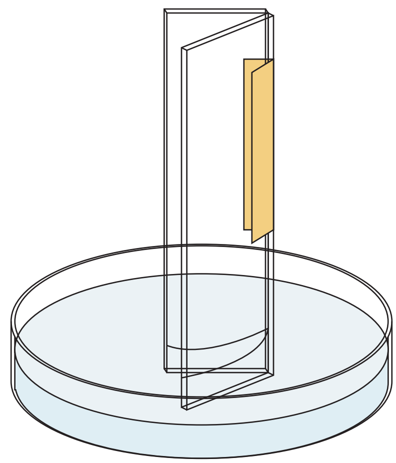
Discovering the Best "Antigravity" Wedge Angle

Name: ______________________

Of course, "antigravity" isn't real, but there are many ways to go against the force of gravity. For example, the muscles in your body work against gravity, enabling you to stand. In this activity, you will investigate how water can rise against gravity.

What do Do:

1. Work in teams and gather the following materials.
   Petri dish or other shallow dish
   Water
   Food coloring
   2 glass microscope slides (handle carefully, they break!)
   Short piece of tape
   2 paper protractors
   Scissors



2. Place a piece of tape along the sides of the two slides to act as a hinge.
3. Cut out and place one paper protractor on the tabletop and the petri dish on top of it.
4. Add a small amount of colored water to the dish (about a quarter inch if enough).
5. Stand the two slides up as shown. Spreading the slides forms a wedge shape. Darken the water with food coloring to make it easier to see.
6. Observe how the water climbs up between the wedge shape.
7. Use the protractor underneath the dish to measure the angle of the wedge.
8. Use the second protractor to estimate the angle the water rises up from the surface into the wedge. This is called the **contact angle.**
9. Change the wedge angle and measure how the contact angle changes. Do this enough times until you discover the best angle for water to rise up in the wedge between the two slides.
10. Fill in the table to the right with your data.
11. On another sheet of paper, create a graph that illustrates this data.

Wedge Angle	Water Contact Angle

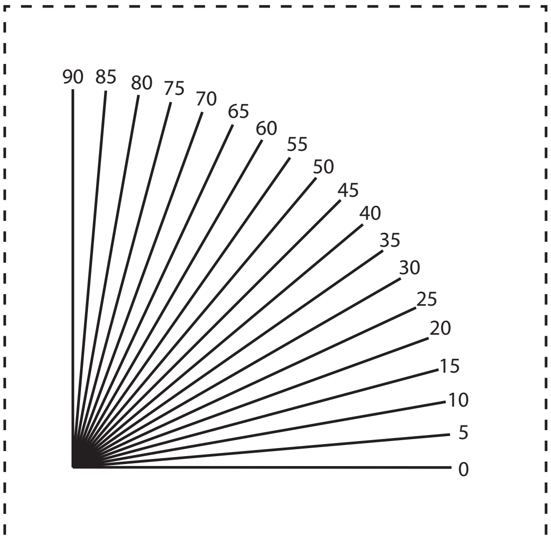
The Question:

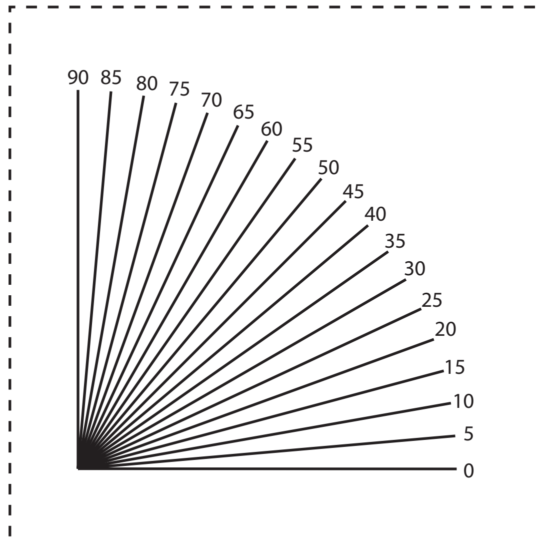
How did Astronaut Donald Pettit's microgravity coffee cup work?

(Use your data to answer this question. Write your answer on the back of this page.)

Paper Protractors

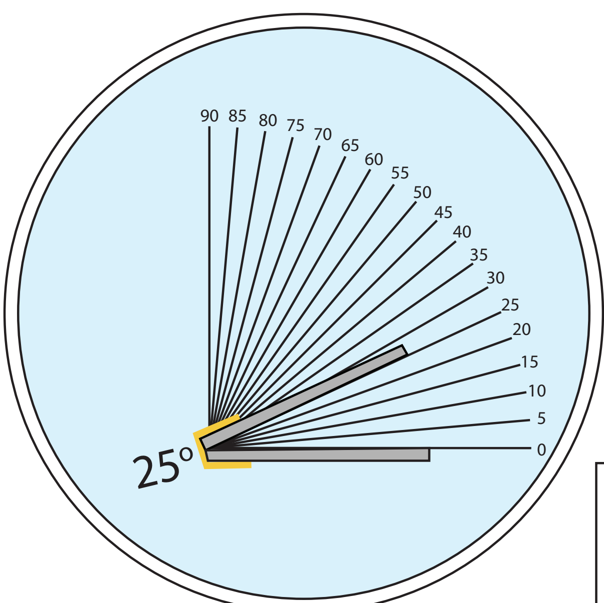
Cut out these protractors on the dashed lines - one for underneath the dish and the other for measuring the contact angles.





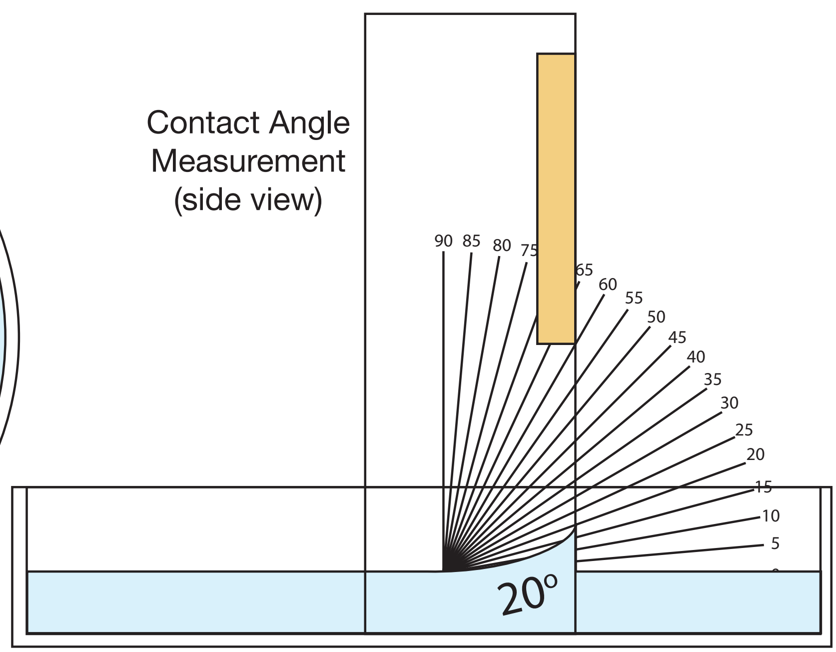
How to Measure Wedge and Contact Angles

Wedge Angle Measurement
(top view)



Measure from where water starts angling upward to the highest point reached. Hold protractor behind petri dish.

Contact Angle
Measurement
(side view)



Design Challenge: Create a New and Improved Microgravity Coffee Cup

Materials: Paper
Tape
Scissors
Overhead projector transparencies (new or used) or plastic cut from water or soda bottles or other like materials
Water
Towels to clean up spills
Student pages
Other materials as thought of by students

Procedure:

1. Give student teams copies of the background page that follows or read it to them.
2. Organize students into R&D (research and development) teams.
3. Show the microgravity coffee cup video and discuss both advantages and disadvantages of the cup.
4. Challenge the teams to design a better cup for microgravity. Refer to the student pages for specific instructions. Teams should first sketch their designs, make paper prototypes and evaluate, and redesign (if necessary) before constructing their demonstration coffee cup from plastic.
5. Have teams test the ability of the cups to hold water (do so over a sink, if possible) and test how well the cup's design transports water upward when the cup is squeezed (adhesion, cohesion, contact angle, capillary action!).
6. Upon completion, have teams give short presentations on the merits of their microgravity coffee cups. Encourage other student teams to ask questions.

Assessment:

- Review team presentations, team designs, prototypes, and the ability of their cups to hold water and transport water.
- Ask students to explain the terms adhesion, cohesion, contact angle, and capillary action.
- Ask students to explain how changing the wedge angle enabled Astronaut Pettit to sip his coffee.

Extensions:

- Compare drink bags currently in use on the International Space Station to commercial foil/plastic drink pouches (e.g., Capri Sun). Similar materials are used but the bags are launched empty to save space and weight. Water (hot or cold) is added to dissolve the dry mix inside. Crew members drink the coffee, juice, tea, etc., through straws.
- Challenge students to invent other space food devices such as a single "spoonforkknife" to cut down on utensils.
- Demonstrate the power of capillary action by placing freshly cut celery stalks (with leaves) in a glass of water dyed with food coloring. Xylem (capillaries) in the stalk transport water and the food color to the leaves through capillary action.

New and Improved Microgravity Coffee Cup Design Challenge

During Space Shuttle flight STS-126, Astronaut Donald Pettit designed and constructed a new kind of drinking cup for coffee. In microgravity (Earth orbit), liquids like coffee are tricky to handle. Liquids will form large spheres that drift around the space craft and make a big mess if permitted to get loose. Consequently, liquids like coffee, tea, juice, and water are contained in foil-coated plastic pouches to keep them under control.

Astronaut Donald Pettit's Microgravity Coffee Cup

Except for flavorings, the pouches are launched empty to save space and weight. To fill a pouch, a large needle from the galley is inserted through a valve built into the pouch. Water, hot or cold, is squirted in and flavoring crystals like instant coffee dissolve. When ready, the astronaut inserts a straw and sips.

Astronaut Pettit thought it would be nice to have a different kind of drink container for drinking hot liquids. He constructed the container from plastic sheets and tape. It looked like a teardrop or the cross section of an airplane wing. By squeezing the narrow edge, coffee moved up from the bottom of the cup to his mouth.

While the cup worked great, it did have a few problems:

1. Pettit had to cut and tape the cup together. (A premade cup would save lots of time.)
2. Pettit had to "brew" his coffee in a regular drink bag and then transfer the coffee to the new cup and throw away the drink bag. (A way to fill the cup directly with coffee without the intermediary drink bag would save waste and time.)
3. The shape of the cup makes removing the last drops of coffee and cleaning the cup difficult. (An easy-to-clean cup would keep it sanitary and save time.)

International Space Station crew members holding plastic/foil drink bags.

Building Upon Astronaut Donald Pettit's Invention,
NASA Would Like Proposals For a New and Improved Microgravity Coffee Cup

New and Improved Microgravity Coffee Cup Design Challenge

Company Name: ____________________

Corporate Design Team Member Names: ____________________

____

____

____

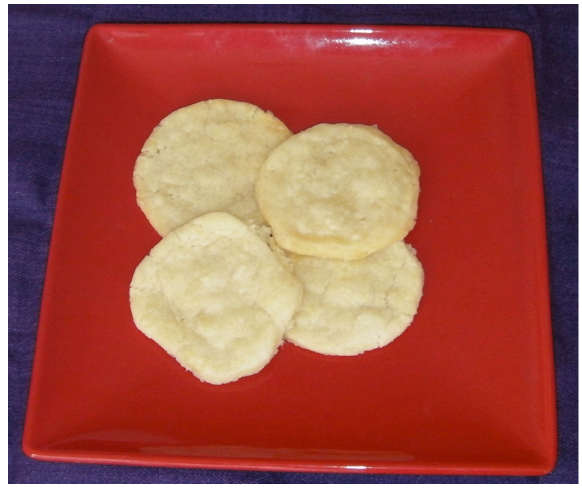
Design Challenge:

- Design and construct a paper model of a coffee cup for use in microgravity. See NASA Design Requirements.
- Construct a working model of your cup and test it.
- Draw a diagram of your cup, with notes, in the space below.
- Create and give a sales presentation for your company's product, describing how it works, what are its good points, and why NASA should buy it.

NASA Design Requirements:

A. Compact for easy prelaunch packing
B. Lightweight to keep launch costs low
C. Directly fillable with liquids
D. Easy to clean and reuse

If You Give An Astronaut A Cookie



Freshly made Skylab Butter Cookies

Quick Look
Students will create and test a cookie recipe for future space flights. They will write out the recipe for others to try and estimate the calories and nutritional value of their creation. Students will also create rubrics that can be used to evaluate different cookie recipes.

Objectives
• Students working individually or in small teams will create a space cookie recipe and bake it for taste testing.
• Students will create nutritional labels for their cookies.
• Students will perform taste tests on all the cookies developed and tabulate the data to determine which cookie recipe is the favorite.

Background
Whether orbiting 300 miles above Earth or rocketing towards the Moon or Mars, astronauts still long for a touch of home. There's no better way to cheer up a homesick astronaut than COOKIES! Cookies are the ultimate space comfort food. Astronauts love them for snacks and with meals. After the early Mercury missions, premade cookies became a regular on space flights.

One cookie recipe favored by many astronauts is the Skylab Butter Cookie. Skylab was the United States' first space station. In the early 1970s, three different crews of astronauts spent 28, 59, and 84 days on Skylab. Skylab butter cookies were packed in small aluminum tins with a metal lid that could be pulled back. From then on, whenever the space food kitchen at the Johnson Space Center was baking fresh batches of the cookies, astronauts and engineers always found an excuse to be nearby. After all, someone had to test the cookies to make sure they were fit for space flight.

Skylab butter cookies are thin and not too sweet. They don't have sprinkles or sugar crystals on top because sprinkles and crystals could come off in microgravity and end up in eyes, noses, and everywhere else. They were just your very basic, very tasty cookie.

Skylab Butter Cookies

6 TBSP unsalted butter
8 1/2 TBSP sugar
1 1/4 TSP vanilla
1 cup plus 2 TBSP cake flour

1. Allow the butter to come to room temperature.
2. Use a mixer to combine the butter with the sugar.
3. Add the flour and vanilla and mix.
4. Roll the dough into small balls about 3/4 inches in diameter. Place them on a baking sheet and flatten them.
5. Bake 15 minutes at 325 degrees. Let cool on a wire rack.

The recipe is very simple and only four or five ingredients are needed. One of the ingredients NASA uses is maltodextrin, a complex carbohydrate powder. NASA would purchase 100 pound bags of the stuff (not very practical for home kitchens unless you are a cookie fanatic). If you don't have maltodextrin, the sugar quantity in the recipe can be increased and the results are great.

Of course, there is more to sending cookies up into space than just baking and packing them in tins. NASA dieticians have to know how many calories and other nutrients the cookies provide so that balanced menus can be developed. You have to eat more than cookies to stay healthy.

Dieticians determine the nutritional value of foods by checking with standard tables that provide nutrient information. The table on the next page gives information for typical cookie ingredients. The numbers were provided by the USDA.

Using the table, the nutritional values of the Skylab Butter Cookies are shown below. Also below is an explanation of how the values were derived from the table on page 32.

The quantities called for in the Skylab butter cookie recipe are different from those in the table. Therefore the nutrient numbers for each ingredient must be recalculated.

Butter: "6 TBSP"
There are 16 tablespoons in a cup. Six tablespoons equals 6/16th of a cup or 0.375 cups of butter. (Divide 16 into 6 to get 0.375.) Multiply the numbers for butter in the Nutrition Table by 0.375.

Skylab Butter Cookies Nutritional Values

Ingredients	Energy KCal	Fat (g)	Protein (g)	Total Carbohydrate (g)	Total Sugar (g)	Fiber (g)	Sodium (mg)	Quantity
Sugar - granular	410.2	0	0	106	106	0	1.1	8.5 TBSP
Butter, unsalted	610	69.1	0.7	0.05	0.05	0	0	6 TBSP
Flour	512	1.4	14.5	107.3	0.4	3.8	2.25	1 Cup + 2 TBSP
Vanilla Extract	15.4	0.004	0.004	0.68	0.68	0	0.42	1 1/4 TSP
Column Totals (whole batch)	1547.6	70.5	15.2	214	107.1	3.8	3.77	
Serving Size - 1 cookie	86	3.9	0.84	11.9	6	0.2	0.2	

Numbers have been rounded off when appropriate.

How the Nutrient Numbers were Estimated for Skylab Butter Cookies

The Nutrition Table on the next page provides nutrient numbers for a range of typical cookie ingredients. The numbers for each ingredient are based on a specific quantities such as a cup or a tablespoon (TBSP). When the ingredient quantities in a recipe are the same as those in the table, the nutrient numbers in the table are used just as they are. However, if the recipe calls for different amounts, the nutrient numbers must be recalculated. For example, if the recipe calls for 1/2 cup of flour instead of the 1 cup shown in the table on page 32, all the nutrient numbers for flour are multiplied by 0.5. If the recipe calls for 2 cups of flour, all the nutrient numbers for flour are multiplied by 2.

Sugar: "8 1/2 TBSP"
Eight and a half tablespoons equals 8.5/16ths of a cup or 0.53 cups. Multiply the numbers for sugar in the Nutrition Table by 0.53.

Flour: "1 cup plus 2 TBSP"
Flour equals 18 tablespoons (18/16ths) or 1.125 cups. Multiply the numbers for all purpose flour in the Nutrition Table by 1.125.

Vanilla: "1 1/4 TSP"
There are 3 teaspoons in a tablespoon. Vanilla equals 1.25/3 teaspoons or 0.42. Multiply the numbers for vanilla extract in the Nutrition Table by 0.42.

Nutrition Table for Typical Cookie Ingredients

The nutritional values for each listed ingredient were determined by the Nutrient Data Laboratory, Agricultural Research Service of the US Department of Agriculture. Their website can be found at the following address.

http://www.nal.usda.gov/fnic/foodcomp/search/

How to use the table:

The nutritional values for each food item listed in the second column from the left are based on specific quantities. For example, butter is given for 1 cup. Shortening is given for 1 tablespoon. The units for the nutritional measurements are given along the top. Energy is in kcal or kilocalories. Sodium is given in mg or milligrams. All the rest of the numbers are given in grams.

What does the Skylab butter cookie look like when it comes to nutrition? Using the recipe and the values in the table, a "nutritional label" can be made for the cookies.

Food Groups	Food Item	Energy KCal	Fat (g)	Protein (g)	Total Carbohydrate (g)	Total Sugar (g)	Fiber (g)	Sodium (mg)	Quantity
Cereal Grains	Wheat Flour - All Purpose	455	1.23	12.91	95.39	0.34	3.4	2	cup
	Oats	607	10.76	26.35	103.38	0	16.5	3	cup
Dairy and Eggs	Milk - Whole	149	7.93	7.69	11.71	12.32	0	105	cup
	Buttermilk - Dried	464	9.64	41.16	58.8	58.8	0	620	cup
	Egg	300	4.75	6.28	0.36	0.18	0	71	Large
Fats and Oils	Butter	1628	184.2	1.93	0.14	0.14	0	1621	cup
	Margarine	803	90.4	0.18	0.78	0	0	732	cup
	Shortening	110	12	0	0	0	0	0	1 TBSP
Fruits	Dates	66	0.04	0.43	17.99	0.13	1.6	0	1
	Cranberries - Dried Sweetened	123	0.55	0.03	32.94	26	2.3	1	cup
	Raisins (not packed)	434	0.67	4.45	114.81	85.83	5.4	16	cup
Leavening Agents	Baking Soda	0	0	0	0	0	0	150	?
Nuts	Almonds	822	70.67	30.34	30.99	5.56	17.4	1	cup
	Peanut Butter	1517	130.1	64.73	50.46	23.79	15.5	1184	cup
	Pecans	684	71.25	9.08	13.72	3.93	9.5	0	cup
	Walnuts	765	76.3	17.80	16.04	3.05	7.8	2	cup
Spices and Flavors	Allspice	16	0.52	0.37	4.33	0	0	5	1 TBSP
	Cinnamon	19	0.1	0.31	6.29	0.17	4.1	1	1 TBSP
	Ginger	17	0.22	0.47	3.72	0.18	0	1	1 TBSP
	Almond Extract (oil)	120	13.6	0	0	0	0	0	1 TBSP
	Lemon Juice	54	0.59	0.85	16.84	6.15	0.7	2	cup
	Vanilla Extract	37	0.01	0.01	1.64	1.64	0	1	1 TBSP
Sweets	Honey	1031	0	1.02	279.34	278.39	0.7	14	Cup
	Molasses	977	0.34	0	251.84	187	0	125	Cup
	Splenda or Other	0	0	0	0	0	0	0	Cup
	Sugar - Brown (packed)	836	0	0.26	215.36	208.03	0	62	Cup
	Sugar - Powdered, Confectioners'	467	0	0	119.72	117.37	0	2	Cup
	Sugar - Granular	774	0	0	199.96	199.6	0	2	Cup
	Chocolate - Semisweet Chips	70	4	1	9	4	0	4	1 TBSP
	Chocolate - Squares, Unsweetened	145	15.17	3.74	8.65	0.26	4.8	7	1 Square
	White Chocolate Chips	70	4	1	9	4	0	4	1 TBSP

Small aluminum food tin with pull-back lid. Tins like this were used on the Skylab mission for small items like puddings and Skylab Butter Cookies.

Since the Skylab Butter Cookie recipe makes 18 cookies, determining the nutritional numbers for a single serving of one cookie requires one more mathematical operation. Each column total has to be divided by 18. Thus, a single Skylab Butter Cookie has about 86 calories and so on. Of course, it's hard to eat just one. You might think you can eat all the cookies you want in microgravity and not put on a pound. That's sort of true because bathroom scales don't work on the International Space Station and your weight would register 0. However, remember: someday you have to come home!

As good as the Skylab Butter Cookies are, astronauts will get tired of them on long missions. Other kinds of cookies will be needed to give variety. The cookies must be firm and not crumbly, provide some nutritional value to astronauts eating them, and pass taste tests. Before a space mission, the entire crew sits down to a tasting meal. All the different food choices available are tried. As far as the cookies go, if the astronauts don't like them, the cookies don't get sent to space!

The Great Space Cookie Bake-Off

Bake the best space cookie ever!

Management Issues:
The Great Space Cookie Bake-Off is an opportunity for students and their families to become involved in a school project. For some students, this may not be possible. The following are some strategies for involving all students.

- Send a letter home with all the students requesting parent volunteers to bake one (or more) batch of the cookies.
- Seek volunteers from the school parent and teacher support group to bake the recipes designed by student teams.
- Ask the school cafeteria staff to assist teams in designing and baking their cookies.

Determining the nutrition numbers for the student-designed cookie recipes may be challenging for your students, especially matching the quantities of ingredients called for in the recipes with the quantities used in the standard table. Refer to the table for the Skylab Butter Cookies and its explanation for details on the process. Consider having teams make spreadsheets for calculating nutritional information.

Procedure

1. Hold a class discussion on the importance of tasty meals for people who are traveling. Ask students to imagine what it would be like to be an astronaut in space on a long mission. What foods would they like to eat?
2. Have students bring in a few store food product packages and examine the nutrition labels. Ask students to review the information on the labels in small groups and ensure they know how to read and interpret them (e.g., why it is important to look at the number of servings in the package). For more information, go to the following U.S. Food and Drug Administration site:

   http://www.fda.gov/Food/LabelingNutrition/ConsumerInformation/ucm078889.htm

3. Explain the purpose of the Great Space Cookie Bake-off.
4. Organize students into cookie development teams. Challenge them to examine various popular cookie recipes and create their own cookie from the ingredients in the Standard

Nutrition Table.

5. While teams are developing their recipe, list their ideas for how the cookies will be evaluated - taste, texture, color, amount of calories, etc. Ask them what NASA would want for space cookies. Talk about why crumbly cookies and those with toppings that can come off are not good in microgravity.
6. Arrange for cookies to be baked (see management notes) and designate a testing day.
7. Prior to testing, have each team develop a rubric with at least five elements (e.g., taste, nutritional value, texture, etc.). As a class, review each rubric and select the most important criteria for judging space cookies. Create a rubric sheet by which all cookies will be judged.

Tip: During testing, student judges should be only allowed to try small pieces of the cookies rather than whole cookies. Bottled water will help clean the pallet between cookies.

8. Have students tabulate the taste test results and pick the best space cookie for taste and for nutritional value.

Assessment

- Collect and review team recipes and nutritional tables.
- Ask students to explain why cookies are an important space food.
- Exhibit the nutritional labels of several store cookies. The nutritional information for popular cookie brands are usually available online. Discuss what makes one cookie healthier to eat than another. Based just on the information in the labels, ask students to pick the healthiest cookie.

Extensions

- Following the selection of the best space cookie, request that the school cafeteria bake the cookie one day for the school lunch dessert.
- Have students design a recipe card that can be distributed by students to family and friends.
- Have student teams develop a marketing strategy for their cookie. If the cookies are great for space flight, they should also be great for commercial sales. Design an attractive store package for the cookies and a pitch that can be given (to the whole class) to promote sales. Have teams determine the suggested retail price based on the cost of the ingredients and the effort in making them (don't forget adding in profit).

The Great Space Cookie Bake-Off

Team Name: ______________________________

____

____

____

____

Things to Plan For

- Cookie should resist crumbling
- Keep it simple - fewer ingredients, easy to make
- Avoid ingredients that spoil easily
- No sprinkles on cookie

Space Cookie Challenge:
Create a space cookie that is nutritious and yummy! After you have tasted and perfected your cookie, write your recipe below. Create a nutritional label for your cookie.

Name Your Cookie: ______________________________

Ingredients: (List items and quantity)

-
-
-
-
-
-
-
-
-
-

Instructions: (Be complete)

____

____

____

____

____

Use other side if you need more space.

The Great Space Cookie Bake-Off

Team Name: ______________________________

Cookie Name: ______________________________

Instructions:

1. List each item used in your recipe and the quantity used.
2. Refer to the Nutritional Table for Typical Cookie Ingredients. The nutrient numbers are listed.

Important!

If you are using the same quantity as listed in the table, the numbers are correct for your recipe. But, if you use a different quantity, you will have to calculate the correct numbers. For example: You use 2 cups of flour. The table provides the numbers for only 1 cup. Therefore, you must double those numbers. One cup of flour has 455 kilocalories. Your recipe has 2 cups or 1,010 kilocalories. If you use half as much for a particular item, divide its numbers by 2. Use the Cooking Conversion Table (Appendix B) if needed to ensure that you calculate the correct quantities.

3. Add up the numbers for each column and place the answers in the Column Totals row.
4. How many cookies does your recipe make? Take that number and divide it into the column totals for each nutrient. Place your answers in the bottom row for Serving Size - 1 Cookie.

Nutritional Label

Ingredients	Energy KCal	Fat (g)	Protein (g)	Total Carbohydrate (g)	Total Sugar (g)	Fiber (g)	Sodium (mg)	Quantity
Column Totals (whole batch)								
Serving Size - 1 cookie								

Nutrition Table for Typical Cookie Ingredients

Instructions:

Use this table to create a nutritional label for your cookie recipe.

If an item is not on the list, you can find the numbers at the following U.S. Department of Agriculture site:

http://www.nal.usda.gov/fnic/foodcomp/search/

If you include water in your recipe, all of the numbers for water except "Quantity" are 0.

Food Groups	Food Item	Energy KCal	Fat (g)	Protein (g)	Total Carbohydrate (g)	Total Sugar (g)	Fiber (g)	Sodium (mg)	Quantity
Cereal Grains	Wheat Flour - All Purpose	455	1.23	12.91	95.39	0.34	3.4	2	cup
	Oats	607	10.76	26.35	103.38	0	16.5	3	cup
Dairy and Eggs	Milk - Whole	149	7.93	7.69	11.71	12.32	0	105	cup
	Buttermilk - Dried	464	9.64	41.16	58.8	58.8	0	620	cup
	Egg	300	4.75	6.28	0.36	0.18	0	71	Large
Fats and Oils	Butter	1628	184.2	1.93	0.14	0.14	0	1621	cup
	Margarine	803	90.4	0.18	0.78	0	0	732	cup
	Shortening	110	12	0	0	0	0	0	1 TBSP
Fruits	Dates	66	0.04	0.43	17.99	0.13	1.6	0	1
	Cranberries - Dried Sweetened	123	0.55	0.03	32.94	26	2.3	1	cup
	Raisins (not packed)	434	0.67	4.45	114.81	85.83	5.4	16	cup
Leavening Agents	Baking Soda	0	0	0	0	0	0	150	?
Nuts	Almonds	822	70.67	30.34	30.99	5.56	17.4	1	cup
	Peanut Butter	1517	130.1	64.73	50.46	23.79	15.5	1184	cup
	Pecans	684	71.25	9.08	13.72	3.93	9.5	0	cup
	Walnuts	765	76.3	17.80	16.04	3.05	7.8	2	cup
Spices and Flavors	Allspice	16	0.52	0.37	4.33	0	0	5	1 TBSP
	Cinnamon	19	0.1	0.31	6.29	0.17	4.1	1	1 TBSP
	Ginger	17	0.22	0.47	3.72	0.18	0	1	1 TBSP
	Almond Extract (oil)	120	13.6	0	0	0	0	0	1 TBSP
	Lemon Juice	54	0.59	0.85	16.84	6.15	0.7	2	cup
	Vanilla Extract	37	0.01	0.01	1.64	1.64	0	1	1 TBSP
Sweets	Honey	1031	0	1.02	279.34	278.39	0.7	14	Cup
	Molasses	977	0.34	0	251.84	187	0	125	Cup
	Splenda or Other	0	0	0	0	0	0	0	Cup
	Sugar - Brown (packed)	836	0	0.26	215.36	208.03	0	62	Cup
	Sugar - Powdered, Confectioners'	467	0	0	119.72	117.37	0	2	Cup
	Sugar - Granular	774	0	0	199.96	199.6	0	2	Cup
	Chocolate - Semisweet Chips	70	4	1	9	4	0	4	1 TBSP
	Chocolate - Squares, Unsweetened	145	15.17	3.74	8.65	0.26	4.8	7	1 Square
	White Chocolate Chips	70	4	1	9	4	0	4	1 TBSP

International Space Station Standard Menu Nutritional Data

Product Name		Mass	Kcals	Pro	CHO	Fat	Sat Fat	Na	K	Mg	Fe	Zn	Ca	P	Fiber
Almonds Миндаль	(NF) (НФ)	45	243	11	11	20.00	1.80	1.67	343	131	1.9	1.5	126	223	6.5
Apple Cider Яблочный сок	(B) (H)	28.7	112.5	0.04	28	0.00	0.00	26.6	2.9	0.8	0	0	72	32	0
Apples with Spice Яблоки со специями	(T) (T/O)	143	137.28	0.4	35.42	0.00	0.00	151.29	133.56	3.56	0.31	0.13	6.05	8.37	1.64
Applesauce Яблочное пюре	(T) (T/O)	128	132	0.13	34	0.05	0.00	9.22	61	2.8	0.1	0	4.6	7	1.5
Apricot Cobbler Абрикосовый пирог	(T) (T/O)	170	330	2.8	66	7.30	3.00	79	287	12	0.61	0.24	21	36	2.7
Asparagus Спаржа	(R) (C/P)	8.4	22	3	4	0.16	0.00	0.9	263	14.5	0.48	0.68	34	66	1.8
Baked Beans Фасоль запеченная	(T) (T/O)	142	158	7	37	0.65	0.00	298	293	34	2.1	1.7	80	76	6
Banana Pudding Банановый пудинг	(R) (C/P)	114	124	2	27	0.80	0.00	111	98	6	0	0	61	48	0
Barbecued Beef Brisket Грудинка в соусе барбекью	(I) (C/O)	118	231	29	14	6.60	2.42	514	465	28	2.8	5.31	12	215	0
Beef Fajitas Говяжья фахита	(I) (C/O)	125	187	31	8	4.80	2.00	841	500	38	2.9	4	23	238	3
Beef Pattie Говяжья котлета	(R) (C/P)	24	89.4	13.9	1	3.30	1.70	272	232.6	14.1	1.9	3	2.9	119.7	0
Beef Steak Бифштекс	(I) (C/O)	100	208	27	1	10.86	4.70	492.3	416	26	2.98	6.32	5.4	337.5	0
Beef Stew Тушеная говядина	(T) (T/O)	198	150.5	19.6	12.3	4.00	1.70	416.2	482	28	1.9	4.69	18.8	165	2.9
Beef Tips w/ Mushrooms Кусочки говядины с грибами	(I) (C/O)	138	182.2	30.9	7.1	5.20	2.20	419.9	343.9	28.7	4.5	5.1	35.1	209.7	4.3
Berry Medley Ассорти из ягод	(R) (C/P)	31	105	1	27	0.00	0.00	1.1	165	17	0.53	0.17	26	23	2.3
Black Beans Черная фасоль	(T) (T/O)	170	114	9	26	0.66	0.00	271	635	66	2.8	1.05	72	173	8
Blueberry Raspberry Yogurt Голубично-малиновый йогурт	(T) (T/O)	140	120	3.5	26	0.24	0.00	42	162	12	0	0	109	88	0
Bran Chex Хлопья из отрубей	(R) (C/P)	40	135	5	31	0.19	0.00	246	276	53	12	3.5	193	192	3.2
Bread Pudding Запеканка из хлеба	(T) (T/O)	170	219	8.8	47	0.10	0.00	226	197	21	1.26	0.7	90	91	1.1
Breakfast Sausage Links Маленькие сосиски	(I) (C/O)	70	155	11.71	4.7	9.90	3.78	614.6	209.37	14.28	0.78	1.62	8.61	116	0
Broccoli au Gratin Брокколи с сыром	(R) (C/P)	30	124	4.8	14	7.00	4.00	740.4	370	22.5	0.35	0.93	120.5	432	3.6

Product Name		Mass	Kcals	Pro	CHO	Fat	Sat Fat	Na	K	Mg	Fe	Zn	Ca	P	Fiber
Brown Rice Шелушёный (коричневый) рис	(T) (Т/О)	121	161	3	37	0.86	0.00	62	127	49	0.7	0.87	10	125	1.8
Brownie Шокол. пирожн. с орех.	(NF) (НФ)	61	268	2	41	10.94	3.00	116	86	20	2	0.4	14.9	69	1.08
Butter Cookies Масляное печенье	(NF) (НФ)	34	150	2	22	6.00	4.00	59	41	4.2	1	0	6	41	0.54
Butterscotch Pudding Пудинг с сиропом из сах.	(T) (Т/О)	114	123	2	27.3	0.82	0.00	131.3	105	6	0.05	0.23	72.5	53	0.57
Candied Yams Сладкий картофель	(T) (Т/О)	170	129	0.92	32	0.56	0.00	264.9	276.4	10.9	0.56	0.24	20.6	21.8	2.2
Candy Coated Almonds Миндаль глазированный	(NF) (НФ)	45	230	4	27	12.00	3.80	18	162	50	0.8	0.8	68	97	1.5
Candy Coated Chocolates Шокол. конф. глазиров.	(NF) (НФ)	30	141	1.5	22	5.60	3.60	18.3	95	18	0.3	0.5	40	48	0.81
Candy Coated Peanuts Арахис глазированный	(NF) (НФ)	45	228	5	27	12.00	5.00	20	173	44	0.76	0.89	42	85	1.4
Caribbean Chicken	(R) (С/Р)		0	0	0	0.00	0.00	0	0	0	0	0	0	0	0
Carrot Coins Морковь нарезанная	(T) (Т/О)	127	42.5	1.2	11.6	0.53	0.00	80	211.3	15.2	0.3	0.2	37	47.1	3.3
Cashews Грехи кешью	(NF) (НФ)	45	265	10	13	20.00	4.00	4.8	324	112	2.5	2.7	16	208	1.5
Cauliflower w/ Cheese Цветная капуста с сыром	(R) (С/Р)	16	55	2.6	9	2.30	1.10	473	263	16	0.44	0.32	50.5	113	2.7
Cheddar Cheese Spread Паста из сыра чеддер	(T) (Т/О)	42.5	178	5.13	1.53	16.80	12.00	704.8	23	6.3	0.15	0.8	165	309	0
Cheese Grits Каша из кукурузной муки с сыр	(T) (Т/О)	142	121	6	20	2.40	1.50	257	130	14	0.21	0.7	214	219	1.4
Cheese Tortellini Вареники по-итальянски	(T) (Т/О)	227	216	10	46	2.25	0.00	487	466	49	2	1.2	192	198	7.72
Cherry Blueberry Cobbler Пирог из вишни и черники	(T) (Т/О)	170	306	2	58	9.35	4.43	139.06	257	16	0.66	0.43	58	98	4.5
Cherry Drink w/ A/S Вишн. напит. с заменит. сах.	(B) (Н)	1.1	3.94	0.05	0.94	0.00	0.00	3.94	4.3	0.29	0.03	0.004	22.78	9.94	0
Chicken Consomme Куриное консоме	(B) (Н)	6.7	14	0.13	2.4	0.40	0.00	1399	14	8	0.001	0	79	8	0
Chicken Fajitas Курица фахита	(T) (Т/О)	142	168.9	27.4	9.1	4.10	0.53	487.4	550.2	41	0.7	0.8	18.1	262	3.4
Chicken in Pouches	(T) (Т/О)	85	90	20	0	1.50	0.50	260	0	0	0	0	0	0	0
Chicken Noodle Soup Куриный суп с вермишелью	(T) (Т/О)	227	134	17.4	14.8	1.36	0.00	345.7	295	29	1	2.8	35	139	1.66
Chicken Teriyaki Цыпленок "терияки"	(I) (С/О)	120	150	27	8	1.00	0.00	1140	540	48	0.64	1	21	274	0

Product Name		Mass	Kcals	Pro	CHO	Fat	Sat Fat	Na	K	Mg	Fe	Zn	Ca	P	Fiber
Chicken w/ Corn & Black Beans Курица с кукурузой и черной фасолью	(T) (Т/О)	170	127.5	14.3	18	1.84	0.00	212	459.3	40	1.45	0.7	18.9	145.5	4.5
Chicken w/ Peanut Sauce Курица с соусом из арахиса	(T) (Т/О)	198	214	25	18	5.56	3.00	393.2	530	52	1.4	1.05	42	275	2.1
Chicken-Pineapple Salad Салат куриный с ананасом	(R) (С/Р)	28.4	128.1	15.5	5.6	5.20	0.90	136.7	272.4	27.6	0.4	0.9	17.3	138	0.8
Chipotle Snack Bread Хлебцы с острым перцем	(NF) (НФ)	57	191.5	4.6	33.4	5.10	1.20	379	115	22	2.2	0.51	183	135	1.64
Chocolate Breakfast Drink Молочный коктейль с шокол.	(B) (Н)	33.7	120	6.3	24	0.40	0.00	170.3	441.1	93	4.2	3	242.2	212.1	1.3
Chocolate Pudding Шоколадный пудинг	(T) (Т/О)	114	124	2.3	27	1.00	0.00	117	163	14	0.6	0.3	61	58	0.8
Chocolate Pudding Cake Шоколадный кекс	(T) (Т/О)	134	319	5.6	57	10.00	6.19	171.1	383	75	6.39	1.17	122	183	6.27
Citrus Fruit Salad Цитрусово-Фруктовый Салат	(T) (Т/О)	142	70	0.81	17	0.14	0.00	6.8	175	9.4	0.13	0.2	21.6	17	0.98
Cocoa Какао	(B) (Н)	50.5	165.6	2.7	43.9	1.10	0.55	152.2	523	36.7	3.1	0.3	51.3	208.5	7.6
Corn Кукуруза	(R) (С/Р)	37	137	4.2	27	3.00	0.70	189	340	31	0.61	0.9	8.7	110	3.7
Cornbread Dressing Кукурузная начинка	(R) (С/Р)	50	195	6.7	35	4.60	2.60	547.8	271	32	1.7	1.1	153	146	3.2
Cornflakes Кукурузные хлопья	(R) (С/Р)	40	147.6	4.5	32.8	0.05	0.00	210.7	172.6	14.7	8.1	0.4	110.7	102.9	0.5
Crackers Крекеры	(NF) (НФ)	18	82	1.3	12	3.20	0.50	152.2	19	3.8	0.56	0.11	7	36	0.3
Cranapple Dessert Клюквенно-яблочный десерт	(T) (Т/О)	177	144	2.42	29	4.10	1.00	43.4	183	30	0.4	0.4	37	58	4.8
Cranberry Peach Drink w/ A/S Клюквенно-персиковый напиток с зам.	(B) (Н)	1.2	4	0.03	1	0.00	0.00	36	15	1.6	0	0	1.6	0.06	0
Crawfish Etouffee Обжаренные тушеные раки	(T) (Т/О)	198	113	6.4	18	2.34	0.00	380.8	302.15	21	2.63	0.85	58	106	1.6
Cream of Mushroom Soup Протертый грибной суп	(R) (С/Р)	27	141	2.9	12	10.00	6.40	852.7	139	11	0.42	0.35	62	73	0.7
Creamed Spinach Протертый шпинат	(R) (С/Р)	18	65	3.3	10	2.00	1.20	544	333	61	0.61	0.39	139	76	1.5
Curry Sauce w/ Vegetables Овощи и соус с приправой карри	(T) (Т/О)	184	107	1.5	23	2.20	2.00	287	504	25	1.3	0.35	35	71	3
Decaf. Coffee Black Черный кофе без кофеина	(B) (Н)	2.5	8	0.4	1.8	0.00	0.00	0.74	86	4	0	0	4	9	0.33
Decaf. Coffee w/ A/S Кофе без кофеина с зам. сах.	(B) (Н)	3	11	0	2	0.00	0.00	3	82	10	0.1	0	4	9	0
Decaf. Coffee w/ C & A/S Кофе б/кофеина со слив. и зам.сах.	(B) (Н)	6.5	30	0.1	4	1.10		7	111	10	0.1	0	5	22	0

Product Name		Mass	Kcals	Pro	CHO	Fat	Sat Fat	Na	K	Mg	Fe	Zn	Ca	P	Fiber
Decaf. Coffee w/ C & S Кофе б/ кофеина со слив. и сах.	(B) (Н)	17	72	0.4	4	1.10		5	96	10	0	0.1	5	16	0
Decaf. Coffee w/ Cream Кофе без кофеина со сливками	(B) (Н)	6	28	0.1	4	1.10		7	111	10	0.1	0	5	22	0
Decaf. Coffee w/ Sugar Кофе без кофеина с сахаром	(B) (Н)	13.5	53	0	14	0.00	0.00	3	82	10	0.1	0	4	9	0
Dried Apricots Сушеные абрикосы (курага)	(IM) (СВ)	62	156	3.7	38	0.16	0.00	13	760	27	1.4	0.41	26	63	3.3
Dried Peaches Сушеные персики	(IM) (СВ)	62	131	2	35	0.15	0.00	2	608	24	0.65	0	14	55	4.5
Dried Pears Сушеные груши	(IM) (СВ)	62	138	2	37	0.00	0.00	6.4	574	25	0.8	0.32	16	57	5
Drinking Water Container Контейнер для питьевой воды	(B) (Н)							0							
Fiesta Chicken Цыпленок фиеста	(T) (Т/О)	227	220	23	16	8.80	3.00	700.8	575	36	0.68	1.4	128	285	3.2
Fruit Cocktail Фруктовая смесь	(T) (Т/О)	128	81	0	21	0.00	0.00	35	109	6	0	0	6	11	1
Granola Хлопья гранола	(R) (С/Р)	80	313	10.42	58	6.00	0.74	173	405	79	2	2.2	140	309	4
Granola Bar Плитка гранола	(NF) (НФ)	28	120	1.4	20	4.20	2.80	51	65	15	0.37	0.7	12	50	0.81
Granola w/ Blueberries Гранола с черникой	(R) (С/Р)	57	230	7	39	7.30	4.23	318.5	318.5	48	1.12	1.2	108	190	4.6
Granola w/ Raisins Гранола с изюмом	(R) (С/Р)	80	315	10	57	7.00	0.90	181	434	80	2.1	2	144	317	3.6
Grape Drink Виноградный напиток	(B) (Н)	17	66.3	0	16.6	0.00	0.00	0.2	0	0.4	0	0	28.8	13	0
Grape Drink w/ A/S Виноградный напиток с зам.сах	(B) (Н)	1.2	4	0.05	1	0.00	0.00	7.6	4	0.06	0	0	10	6	0
Grape Jelly Виноградное желе	(T) (Т/О)	28	75	0	19	0.00	0.00	5	5.5	2	0	0	1.6	1.8	0.14
Grapefruit Drink Грейпфрутовый напиток	(B) (Н)	35	119.7	1.5	28.4	0.01	0.00	11.8	376.8	21.6	0.3	0.1	24.5	38	0
Green Beans w/ Mushrooms Зеленая фасоль с грибами	(R) (С/Р)	10	22	1.8	7	0.20	0.00	178	79	17	0.6	0.3	40	27	3.2
Green Tea Чай зеленый	(B) (Н)	2	0	0	0	0.00	0.00	0	1	0.03	0	0	0.01	0.03	0
Green Tea w/ Sugar Чай зеленый с сахаром	(B) (Н)	18	71	0	18	0.00	0.00	1.6	12	0.7	0	0	0.56	0.97	0
Grilled Pork Chop Свиная отбивная на гриле	(T) (Т/О)	142	261	32.5	3.7	13.00	5.00	281	530.5	31.1	0.74	0	10.5	225	0
Grits w/ Butter Каша из кукур. муки с масл.	(R) (С/Р)	34.5	117	2.3	27	0.30	0.00	509.2	56	11	13	0.22	127	36	0.8

Product Name		Mass	Kcals	Pro	CHO	Fat	Sat Fat	Na	K	Mg	Fe	Zn	Ca	P	Fiber
Homestyle Potatoes Картофель по-домашнему	(T) (T/O)	142	160	3.5	30	6.00	1.50	225	656	37	0.84	0.51	25	77	7
Hot and Sour Soup Острокислый суп	(T) (T/O)	170	54.4	7.8	9.8	0.99	0.00	299.5	184	22.5	0.97	0.41	25	64	0.99
Italian Vegetables Овощи по-итальянски	(R) (C/P)	20	92	2.1	10.14	5.93	0.70	250	141.4	16.5	0.67	0.3	22.34	36	2.6
Kona Coffee Black Черный кофе Кона	(B) (H)	1.5	4.3	0.2	1	0.00	0.00	0.2	61.4	5.3	0.1	0	2.4	5	0.2
Kona Coffee w/ A/S Кофе Кона с зам. сах.	(B) (H)	2	6	0.3	1.4	0.00	0.00	0.71	63	4.9	0	0	2	4	0.25
Kona Coffee w/ C & A/S Кофе Кона со слив. и зам. сах.	(B) (H)	5.5	18	0.3	4.6	0.00	0.00	3.8	83	6	0	0	2.7	19	0.6
Kona Coffee w/ C&S Кофе Кона со сливками и сах.	(B) (H)	16	68	0.1	14	1.10		9	93	6	0.1	0	3	20	0
Kona Coffee w/ Cream Кофе Кона со сливками	(B) (H)	5	16	0.3	4	0.00	0.00	3	99	8	0	0	3	18	0.7
Kona Coffee w/ Sugar Кофе Кона с сахаром	(B) (H)	12.5	49	0	12	0.00	0.00	5	64	5	0.1	0	2	7	0
Lasagna with Meat Лазанья с мясом	(T) (T/O)	227	202	20	31.7	5.40	3.00	788	576	53	1.3	3.1	204	277	13
Lemon Curd Cake Пирожное с лимонной помадкой	(T) (T/O)	130	460	4	76	16.20	8.00	243	82	10	1.5	0.4	137	238	1.33
Lemon Meringue Pudding Лимонно-меренговый пуддинг	(T) (T/O)	117	140	2	28	2.00	1.00	140							0
Lemonade Лимонад	(B) (H)	21	81	0	20	0.00	0.00	30	1.6	35	0.01	0.03	3.3	24	0
Lemonade w/ A/S Лимонад с зам. сах.	(B) (H)	1.9	7	0.04	1.7	0.00	0.00	14	55	16	0	0	2.5	1.44	0
Lemon-Lime Drink Лимонный напиток	(B) (H)	16	62	0	16	0.00	0.00	132	36	0	0	0	0.42	27	0
Macadamia Nuts Гавайские орешки макадамия	(NF) (НФ)	45	308	3.6	11	29.00	4.70	4.14	181	51	0.75	0.59	19	77	3
Macaroni & Cheese R Макароны с сыром	(R) (C/P)	40	194	8.5	20	9.23	4.80	643.6	101	20	0.5	1.1	152	135	1.23
Mango Peach Smoothie Фруктовый напиток из манго и персика	(B) (H)	50	200	1.3	46	1.20	1.10	57	136	3.8	0.25	0.1	66	62	0
Maple Muffin Top Кекс, пропитанный кленовым сиропом	(NF) (НФ)	62	250	3	30	13.00	3.50	230	0	0	0	0	0	0	0
Mashed Potatoes Картофельное пюре	(R) (C/P)	22	71	2	16	0.90	0.23	331	362	16	0.34	0	8.3	43	2.1
Meatloaf Мясной рулет	(T) (T/O)	119	177.3	17.3	16.4	4.70	2.20	698.6	499.4	32.4	2.7	3.1	22.5	173	0
Mexican Scrambled Eggs Омлет по-мексикански	(R) (C/P)	36	202	14	7	13.50	6.55	345.7	266	21	1.5	1.5	144	251	0

Product Name		Mass	Kcals	Pro	CHO	Fat	Sat Fat	Na	K	Mg	Fe	Zn	Ca	P	Fiber
Milk Молоко коровье	(B) (H)		0	0	0	0.00	0.00	110	0	0	0	0	0	0	0
Minestrone Soup Суп минестрони	(T) (T/O)	227	84	3.09	16.3	2.00	0.00	251.3	462.9	31.37	1.41	0.43	53.8	65	2.6
Mixed Vegetables Овощная смесь	(T) (T/O)	113	57	3.4	12.5	1.30	0.00	47	249	26	0.97	0.5	25	62	4.6
Noodles & Chicken Лапша с курицей	(R) (C/P)	28	105	4.2	18.9	1.70	0.50	552.7	98	11.3	0.5	0.35	12	60.5	0.83
Nut & Fruit Granola Bar Плитка гранола с орехами и фруктами	(NF) (НФ)	35	135	2.9	24	3.90	0.40	90.23	90	29	0.63	0.6	204	69	2
Oatmeal w/ Brown Sugar Овсяная каша с нераф. сах.	(R) (C/P)	46.1	170	5	35	1.80	0.40	233	178	44	3.8	0.89	134	157	1.7
Oatmeal w/ Raisins & Spice Овс. каша с изюмом и пряност.	(R) (C/P)	47.2	162	3.2	38	0.90	0.00	307	185	32	5.7	0.67	146	113	2.5
Orange Drink Апельсиновый напиток	(B) (H)	11.9	43	0.02	11	0.00	0.00	2.4	2.1	1.5	0	0.14	107.5	51	0
Orange Drink w/ A/S Апельсиновый нап. С зам. Сах.	(B) (H)	2.3	7	0.06	2	0.00	0.00	3.4	80	7.8	0	0	28	15	0
Orange Juice Апельсиновый Сок	(B) (H)	35	123.6	1.6	29.2	0.00	0.00	8.3	438.8	22.8	0.3	0	21.3	36.6	0.8
Orange-Grapefruit Drink Апельсин.-грейпфрут. напиток	(B) (H)	19.9	73	0.5	18	0.00	0.00	25	113	6	0.2	0	18	16	0
Orange-Mango Drink Апельсиново-мангов. напиток	(B) (H)	8.9	32	0.03	8	0.00	0.00	10	8	1	0	0	159	134	0
Orange-Pineapple Drink Апельсиново-ананас. напиток	(B) (H)	8.9	30	0	8	0.00	0.00	10	6	1	0	0	137	115	0.28
Pasta w/ Pesto Sauce Макаронные изделия в соусе "песто"	(T) (T/O)	114	124	7	25	0.50	0.00	337	62	22	1.1	0.8	40	70	2.5
Pasta w/ Shrimp Лапша с креветками	(R) (C/P)	40	135.6	10.5	23	0.74	0.00	581	200	31	0.9	0.83	33	140	1.4
Peach-Apricot Drink Персиково-абрикос. напиток	(B) (H)	26.9	104	0	26	0.00	0.00	0.35	1.4	0	0	0	0.81	0.13	0
Peaches Персики	(T) (T/O)	153	75	0.64	20	0.11	0.00	6.9	241	8.34	0.09	0.15	8.1	22.5	2.46
Peanut Butter Арахисовое масло	(T) (T/O)	32	205	8	5.5	17.00	4.40	2.4	234	69	0.66	1.2	15	152	1.3
Peanuts Арахис	(NF) (НФ)	45	274	13	7.5	22.00	4.30	0.54	325	88	0.68	1.3	30	174	2.8
Pears Груши	(T) (T/O)	128	61	0.24	15	0.12	0.00	3.5	46	5	0.4	0.05	5	9.6	0.6
Pineapple Ананас	(T) (T/O)	128	91	0.5	23.8	0.04	0.00	63.5	156	18	0.3	0.2	18	10	1.7
Pineapple Drink Ананасовый напиток	(B) (H)	4.9	17	0.06	4	0.06	0.00	5.8	7.5	0.63	0.09	0	111	100	0

Product Name		Mass	Kcals	Pro	CHO	Fat	Sat Fat	Na	K	Mg	Fe	Zn	Ca	P	Fiber
Potato Medley Картофельная смесь	(T) (T/O)	142	139	2.4	30.2	2.80	1.00	73.3	566.6	26.1	0.7	1.72	21.6	95	4.09
Potato Soup Картофельный суп	(T) (T/O)	234	124	3.9	22	3.50	2.10	325.5	426	25	0.35	0.56	81	111	2.6
Potatoes au Gratin Картофель с сыром	(R) (C/P)	30	141	4	16	7.00	2.50	606	187	16	0	0.61	109	126	1.2
Red Beans & Rice Красная фасоль с рисом	(T) (T/O)	227	159	10	36	0.45	0.00	292.4	624	64	3.34	1.43	61	191	7.9
Rhubarb Applesauce Яблочно-Ревеневое Пюре	(T) (T/O)	142	56.8	0.64	15.5	0.23	0.00	6	197	7.34	0.23	0.26	35.5	16.9	3.15
Rice & Chicken Рис с курицей	(R) (C/P)	34	154	3.5	22	5.80	1.00	595	40	6.2	0.2	0.52	8	42	0.41
Rice Pilaf Плов	(R) (C/P)	25	103	2	20	1.80	1.20	369	48	8.5	0.21	0.27	20	37	0.5
Rice Pudding Рисовый пудинг	(R) (C/P)	38.5	142	3	31	0.80	0.47	95	189	11	0.06	0.53	67	59	0.93
Rice w/ Butter Рис с маслом	(T) (T/O)	115	168	3.2	34	2.70	1.40	180	20	3.3	0.3	0.32	5.8	27	1.2
Salmon Лосось	(T) (T/O)	74	85	16	1.74	1.50	0.50	372	255	26	0.43	0.4	22	173	0
Sausage Pattie Котлета из сосисочного фарша	(R) (C/P)	18	127	4.5	0.5	12.00	4.20	292	73	6	0.28	0.51	6	81	0.09
Scrambled Eggs Омлет	(R) (C/P)	34.5	183	13	6	12.00	6.00	333.3	254	20	1.2	1.4	128	225	0.91
Seafood Gumbo Суп из стручков с морскими продуктам	(T) (T/O)	198	129	13	10.55	4.50	2.00	293	471	24	1.45	1.72	55	162	1.92
Seasoned Scrambled Eggs Омлет с приправами	(R) (C/P)	35	187	13	6.3	13.00	6.20	401.6	264	33	1.1	1.2	147	254	0.8
Shortbread Cookies Песочное печенье	(NF) (НФ)	29	139	1.4	20	6.00	1.60	111	25	3.7	1.1	0	3	17	0.4
Shrimp Cocktail Закуска из креветок	(R) (C/P)	35	117.95	14.14	13.74	0.70	0.16	705.25	217.32	26.41	0.12	1.1	50.75	152.67	1.4
Shrimp Fried Rice Рис с жареными креветками	(R) (C/P)	32	114.56	11.54	15.91	0.54	0.00	413.4	76.19	16.69	0.25	1.19	28.93	191.2	0.66
Smoked Turkey Копченая индейка	(I) (C/O)	90	108	19	0.44	3.00	1.30	757	248	15	0.64	1	4	211	0
Southwestern Corn Кукуруза по-юго-западному	(T) (T/O)	170	124.1	3.98	26.33	1.48	0.00	245.82	343.4	27.66	0.53	0.71	15.81	103.87	2.65
Split Pea Soup Суп из лущеного гороха	(T) (T/O)	227	180	14	33	1.23	0.00	283	515	51	3.02	1.56	30	235	4.65
Strawberries Клубника	(R) (C/P)	28	89	1	23	0.00	0.00	7	204	18	0.35	0.14	28	33	1.6
Strawberry Drink Клубничный напиток	(B) (H)	5.6	19	0	4.6	0.00	0.00	13	9	0.94	0.14	0	140	136	0

Product Name		Mass	Kcals	Pro	CHO	Fat	Sat Fat	Na	K	Mg	Fe	Zn	Ca	P	Fiber
Sweet & Sour Chicken Курица в кисло-сладком соусе	(R) (C/P)	36	144	21	11	2.00	0.30	223.7	263	23	0.1	0.7	5	159	0.3
Sweet & Sour Pork Свинина в кисло-сладком соусе	(T) (T/O)	198	178	8.2	30.7	3.40	0.90	519.2	312	18	1.1	1.2	20	121	2.1
Tea Чай	(B) (H)	1	2.57	0.2	0.63	0.00	0.00	0.5	73.5	4.16	0	0	1.3	2.7	0.1
Tea w/ Cream & Sugar Чай со сливками и сахаром	(B) (H)	10.7	41	0.19	10	0.05	0.00	2.5	93	4.2	0	0	1.1	8	0.15
Tea w/ Lemon & A/S Чай с лимоном и зам. сах.	(B) (H)	2	7	0.1	1.7	0.00	0.00	0.6	51	3.5	0.1	0.01	0.5	0.6	0
Tea w/ Lemon & Sugar Чай с лимоном и сахаром	(B) (H)	21	84	0	21	0.00	0.00	1.9	57	1.5	0	0	12	6	0
Tea w/ Sugar Чай с сахаром	(B) (H)	13.5	53	0.15	13	0.00	0.00	0.4	60	3	0	0	1.2	2.3	0
Tea with A/S Чай с заменителем сахара	(B) (H)	1.5	5	0.2	1	0.00	0.00	4	73	4	0	0	1	3	0
Tea with Cream Чай со сливками	(B) (H)	2.7	22	0.3	3	1.10		6	88	4	0	0	1	9	0
Tea with Lemon Чай с лимоном	(B) (H)	1.4	5	0.04	1.2	0.00	0.00	1.4	32	1	0	0	0.5	0.7	0
Teriyaki Beef Steak Ббифштекс в соусе терияки	(I) (C/O)	120	234	39	4	6.80	2.70	863	550	46	3.4	6	12	313	0
Teriyaki Chicken Курица в соусе терияки	(R) (C/P)	37	142	23	9	1.80	0.90	977.2	290	26	0.42	0.7	18	177.5	0.23
Teriyaki Vegetables Гвощи в соусе терияки	(R) (C/P)	18.5	47	3.7	11	0.12	0.00	633	315	28	0.63	0.5	45	71	3
Tofu w/ Hoisin Sauce Соевый творог с соусом "хойсин"	(T) (T/O)	142	125	12	17.8	1.50	0.00	660.4	305.2	45.4	2.1	0.87	65.6	133.6	1.8
Tofu w/ Hot Mustard Sauce Соевый творог с острым горчичным	(T) (T/O)	135	111	11	15	1.40	0.00	197	312	0.53	1.1	0.93	85	128	1.8
Tomato Basil Soup Томатный суп с базиликом	(T) (T/O)	170	54.4	2.4	8.9	1.90	0.00	535.3	451.9	27.9	0.8	0.4	76.8	65.3	2.1
Tomatoes & Artichokes Помидоры с артшоками	(R) (C/P)	15	44.7	2.1	8.84	1.30	0.24	340.5	265	31	2.11	0.33	39.74	55	2.6
Tomatoes & Eggplant Помидоры и баклажаны	(T) (T/O)	170	65	1.7	10	3.80	0.66	582	463	23	0.08	0.22	35	44	4
Tortillas Лепешка тортия	(NF) (НФ)	60	189	5	34	4.00	1.00	421	132	14	2.5	0.46	74	62	1
Trail Mix Сухофрукты и орехи	(IM) (СВ)	50	215	4	33	8.60	2.80	29	126	33	0.8	0.5	18	56	2
Tropical Fruit Salad Салат из тропических фруктов	(T) (T/O)	142	81	0.37	21	0.08	0.00	12	85	9	0.21	0.06	37	6.5	1.9
Tropical Punch Пунш "тропический"	(B) (H)	25	97	0	24	0.00	0.00	1.7	0.95	45.5	0.1	0.03	44	19	0

Product Name		Mass	Kcals	Pro	CHO	Fat	Sat Fat	Na	K	Mg	Fe	Zn	Ca	P	Fiber
Tropical Punch w/ A/S Пунш "тропический" с зам.сах.	(B) (H)	1.5	5	0.06	1.26	0.00	0.00	13	20	0.29	0.03	0	27	15	0
Tuna Тунец	(T) (T/O)	74	79	17	2	0.00	0.00	118	275	27	0	0	3	177	0
Tuna Salad Spread Паштет из тунца	(T) (T/O)	85	100	13	4	3.00	1.00	410	170			0			1
Turkey Tetrazzini Индейка с соусом Тетразини	(R) (C/P)	27	117	8.6	12	4.20	1.00	367	183	16	0.56	0.95	47	100	0.72
Vanilla Breakfast Drink Молочный коктейль с ванилью	(B) (H)	38.8	136	7.5	27	0.00	0.00	168.3	77	79	3.7	3	681	242	0.3
Vanilla Pudding Ванильный пудинг	(T) (T/O)	114	128	2	29	0.63	0.00	156	109	6	0	0	68	52	0
Vegetable Quiche Овощной пирог (киш)	(R) (C/P)	50	271	15.5	13	18.00	11.50	462	418	31	0.94	2.5	339	321.5	1.3
Vegetarian Vegetable Soup Вегетарианский овощной суп	(T) (T/O)	227	95	2	23	0.30	0.00	389	363	22	0.93	0.38	29	55	1.7
Waffles Вафли	(NF) (НФ)	43	208	3	23	12.00	2.60	100	53	6	2	0	18	37	0.5
Wheat Flat Bread Лаваш пшеничный	(NF) (НФ)	57	194	5	33	5.00	1.00	381	86	22	2	0.4	160	156	1.6
Yogurt Covered Granola Bar Плитка гранола с йогуртовым покрытие	(NF) (НФ)	35	159	3.9	20	7.50	2.30	125.5	111	39	0.7	0.6	46	78.5	3

FOOD TYPES:
NF - Natural Form
B - Beverage
T - Thermostabilized
R - Rehydratable
I - Irradiated
IM - Intermediate Moisture
FF- Fresh Food

Mass – in grams (g)
Kcals – energy, in kilocalories
Pro – protein, in grams (g)
CHO – carbohydrates, in grams (g)
Fat – in grams (g)
Sat Fat – saturated fat, in grams (g)
Na – sodium, in milligrams (mg)
K – potassium, in milligrams (mg)
Mg – magnesium, in milligrams (mg)
Fe – iron, in milligrams (mg)
Zn – zinc, in milligrams (mg)
Ca – calcium, in milligrams (mg)
P – phosphorous, in milligrams (mg)
Fiber – in grams

Appendix B

Cooking Conversion Table

Unit:	Equals:	Also equals:	Also equals:	
1 tsp.	1/6 fl. oz.	1/3 Tbsp.	1/48 Cup	
1 Tbsp.	1/2 fl. oz.	3 tsp.	1/16 Cup	
1/8 cup	1 fl. oz.	2 Tbsp.	6 tsp.	
1/4 cup	2 fl. oz.	4 Tbsp.	12 tsp.	
1/3 cup	2¾ fl. oz.	5 Tbsp. plus 1 tsp.	16 tsp.	
1/2 cup	4 fl. oz.	8 Tbsp.	24 tsp.	
1 cup	8 fl. oz.	1/2 pint	16 Tbsp.	48 tsp.
1 pint	16 fl. oz.	2 cups	32 Tbsp.	96 tsp.
1 quart	32 fl. oz.	2 pints	64 Tbsp.	192 tsp.
1 gallon	128 fl. oz.	4 quarts	256 Tbsp.	768 tsp.