The NASA SCI Files™

The Case of the Great Space Exploration

Segment 2

Bianca goes to Space Camp in Huntsville, Alabama to learn how an astronaut trains for space travel. Meanwhile, Catherine goes to NASA Johnson Space Center in Houston, Texas to talk to Dr. Grant Schaffner about the effects of long-term space travel on the human body. Dr. Schaffner emphasizes the importance of exercise to overcome the effects of space travel. Next, Catherine visits Ms. Janis Davis-Street to learn why it is important for astronauts to eat a healthy, well-balanced diet while on Earth and in space. The NASA SCI Files™ Kids' Club at Maryvale Elementary School in Rockville, Maryland helps the detectives learn more about Calories, serving sizes, and the Food Pyramid. Finally, the detectives meet Dr. D in his lab, where he just needs to make a few computations on his robots.

Objectives

Students will

- demonstrate the effects of microgravity on the human body
- investigate bone loss in microgravity environments
- determine Basal Metabolic Rate (BMR)
- calculate total energy needs
- measure the amount of energy contained in particular foods
- demonstrate food dehydration
- examine the challenges faced by scientists when exploring unknown territories
- analyze the benefits of stereoscopic vision
- investigate three-dimensional technology

Vocabulary

Basal Metabolic Rate (BMR) – an estimate of a person's energy needs at rest

calorie – the unit for measuring the energy supplied by food; based on the large Calorie or the amount of heat energy needed to raise the temperature of a kilogram of water one degree centigrade

exercise – activity that requires physical exertion, especially when done to develop or maintain fitness

microgravity – an environment where astronauts are freely falling towards the Earth and feel nearly weightless

nutrition – food or nourishment

robotics – the study and design of robots, mechanical devices that can perform work and collect data

rovers – a spacecraft that is designed to land on a planet and move from one location to another to collect data

serving – a recommended portion size

stereo cameras – two cameras spaced some distance apart, which take pictures of the same scene at the same time to simulate depth perception

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 2 of *The Case of the Great Space Exploration*, discuss the previous segment to review the problem and reaffirm what the tree house detectives have learned thus far. Download a copy of the **Problem Board** from the NASA SCI Files™ web site, select **Educators**, and click on the **Tools** section. The **Problem Board** can also be found in the **Problem-Solving Tools** section of the latest online investigation. Have students use it to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 1 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 1. Use tools located on the Web, as was previously mentioned in Segment 1.
4. Review the list of ideas and additional questions that were created after viewing Segment 1.
5. Read the Overview for Segment 2 and have students add any questions to their lists that will help them better understand the problem.
6. **Focus Questions**—Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes while viewing the program to help them answer the questions. An icon will appear when the answer is near.
7. **"What's Up?" Questions**—These questions at the end of the segment help students predict what actions the tree house detectives should take next in the investigation process and how the information learned will affect the case. They can be printed from the web site ahead of time for students to copy into their science journals.

View Segment 2 of the Video

For optimal educational benefit, view *The Case of the Great Space Exploration* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. Have students reflect on the "What's Up?" Questions asked at the end of the segment.
2. Discuss the Focus Questions.
3. Have students work in small groups or as a class to discuss and list what new information they have learned about space flight, the reasons we explore space, and how astronauts train for a mission.
4. Organize the information and determine whether any of the students' questions from the previous segments were answered.
5. Decide what additional information is needed for the tree house detectives to better understand future space exploration. Have students conduct independent research or provide students with information as needed. Visit the NASA SCI Files™ web site for an additional list of resources for both students and educators.
6. Choose activities from the **Educator Guide** and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.

Careers

astronaut strength conditioning and rehabilitation specialist
dietitian
exercise equipment designer
fitness trainer
health scientist
nutritionist

7. For related activities from previous programs, download the **Educator Guide**. On the NASA SCI Files™ home page, select **Educators**. Click on **Episodes** in the menu bar at the top. Scroll down to the 2002–2003 Season and click on *The Case of the Galactic Vacation*. In the green box, click on **Download the Educator Guide.**

a. In the Educator Guide, you will find

1. Segment 2 – *The Taste of the Matter*

2. Segment 2 – *Dressing for Space*

Close the PDF window to return to the Educator Guide page. Using the yellow back arrow on the NASA SCI Files™ page *(do NOT use the back button on your browser)*, return to the Episode description page. In the green box, click on **Activities/Worksheets**.

b. On the web site in the **Activities/Worksheet** section, you will find

1. My Life as an Astronaut

2. Too Short?

Close the PDF window to return to the Educators Activities page. Click on **Episodes** in the menu bar at the top. Scroll down to the 2002–2003 Season and click on *The Case of the Biological Biosphere*. In the green box, click on **Download the Educator Guide**.

a. In the Educator Guide you will find

1. **Segment 3** – *You Are What You Eat*

2. **Segment 3** – *Fitness for Life*

3. **Segment 4** – *Flexing Your Muscles*

4. **Segment 4** – *Flexibility Is the Key*

5. **Segment 4** – *Getting to the Heart of the Matter*

Close the PDF window to return to the Educator Guide page. Using the yellow back arrow on the NASA SCI Files™ page, return to the Episode description page. In the green box, click on **Activities/Worksheets**.

b. On the web site in the **Activities/Worksheet** section, you will find

1. *Where Are the Nutrients?*

2. *Body System Booklet*

Close the PDF window and return the **Educators Activities** page. Click on **Episodes** in the menu bar at the top. Scroll down to the 2001–2002 Season and click on *The Case of the Inhabitable Habitat*. In the green box, click on **Download the Educator Guide**.

a. In the **Educator Guide** you will find

a. **Segment 3** – *Vomit Comet*

b. **Segment 3** – *Properly Gloved*

8. If time did not permit you to begin the web activity at the conclusion of Segment 1, refer to number 6 under **After Viewing** on page 15 and begin the Problem-Based Learning activity on the NASA SCI Files™ web site. If the web activity was begun, monitor students as they research within their selected roles, review criteria as needed, and encourage the use of the following portions of the online, Problem-Based Learning activity:

- **Research Rack**–books, Internet sites, and research tools
- **Problem-Solving Tools**–tools and strategies to help guide the problem-solving process
- **Dr. D's Lab**–interactive activities and simulations
- **Media Zone**–interviews with experts from this segment
- **Expert's Corner**–listing of Ask-an-Expert sites and biographies of experts featured in the broadcast

9. Have students write in their journals what they have learned from this segment and from their own experimentation and research. If needed, give students specific questions to reflect upon as suggested on the **PBL Facilitator Prompting Questions** instructional tool found by selecting **Educators** on the web site.
10. Continue to assess the students' learning, as appropriate, by using their journal writings, problem logs, scientific investigation logs, and other tools that can be found on the web site. For more assessment ideas and tools, go to **Educators** and click on **Instructional Tools** in the menu bar.

Resources *(additional resources located on web site)*

Books

Berger, Melvin and Berger, Gilda: *Can You Hear a Shout in Space?: Questions and Answers About Space Exploration*. Scholastic, Inc., 2000, ISBN: 0439148790.

Bredeson, Carmen, Vargus, Nanci R., and Palaquibay, Minna Gretchen: *Getting Ready for Space*. Scholastic Library Publishing, 2003, ISBN: 0516269534.

Fritz, Sandy: *Robotics and Artificial Intelligence*. Smart Apple Media, 2004, ISBN: 1583403647.

Haduch, Bill: Food Rules!: *What You Munch, Its Punch, Its Crunch, and Why Sometimes You Lose Your Lunch*. Puffin, 2001, ISBN: 0141311479.

Hayden, Kate: *Astronaut, Living in Space*. DK Publishing, 2000, ISBN: 0789454211.

Jacobson, Michael F. and Hill, Laura: *Kitchen Fun for Kids: Healthy Recipes and Nutrition Facts for 7–12-Year Old Cooks.* Henry Holt & Company, 1991, ISBN: 0805016090.

Nicholson, Cynthia Pratt: *Exploring Space*. Kids Can Press, Limited, 2000, ISBN: 1550747134.

Vogt, Gregory and Shearer, Deborah: *Robotix Robot Inventor's Workshop*. Running Pres Book Publishers, 2000, ISBN: 0762407417.

Video

Dealstar Video: *Case of the U.S. Space Camp Mission* (starring the Olsen twins)
Grades K–4

Discovery Channel School: *The Food Pyramid*
Grades 3–6

Discovery Channel School: *People and Space*
Grades 3–6

Schlessinger Media: *All About Nutrition and Exercise*
Grades K–4

Web Sites

Space Camp
Learn about space camp and aviation challenge programs offered for students and adults.
http://www.spacecamp.com/camponline/index.jsp

NASA Johnson Space Center
Find out about programs, news, and research going on at NASA Johnson Space Center in Houston, Texas.
http://www.jsc.nasa.gov/

Living and Working in Space
In many ways, living in space is not very different from living on Earth. In other ways, it is quite different. Space travelers in orbit above the Earth eat, work, exercise, relax, maintain hygiene, and sleep. Learn about endeavors to sustain life on future missions into unfamiliar territories.
http://spacelink.nasa.gov/NASA.Projects/Human.Exploration.and.Development.of.Space/Living.and.Working.In.Space/.index.html

KidsHealth
On this web site, you can learn all about nutrition, ways to stay healthy, fitness, and many other fun topics. There are fun activities and cool movies to view.
http://kidshealth.org/kid/

NASA Spacelink – Space Food
Space food to the Mercury astronauts meant freeze-dried powders and semi-liquids in aluminum tubes. The astronauts on the International Space Station can choose from shrimp cocktail, stir fried chicken, and Fettuccine Alfredo. Use the resources here to design your space meals for a day.
http://spacelink.nasa.gov/NASA.Projects/Human.Exploration.and.Development.of.Space/Living.and.Working.In.Space/Space.Food/

Society of Women Engineers
The Society of Women Engineers is the largest nonprofit educational and service organization representing both student and professional women in engineering and technical fields. Visit this site to learn about their objectives and missions.
http://www.swe.org/

NASA Spacelink - Robotics
Robots and human beings working together are demonstrating new exploration strategies. This page offers information and activities that explain how robots play an important role in space exploration.
http://spacelink.nasa.gov/Instructional.Materials/Curriculum.Support/Technology/Robotics/

National Space Biomedical Research Institute (NSBRI)
Visit this web site for some great activity guides for teachers. Download the series of educational units developed by the Baylor College of Medicine-*From Outerspace to Innerspace: Activity Guides for Teachers*. Units include *Sleep and Daily Rhythms*, *Muscles and Bones*, and *Food and Fitness*.
http://www.nsbri.org/Education/Elem_Act.html

Activities and Worksheets

Puffy Head, Bird-Leg Syndrome

Segment 2

Purpose

To demonstrate the effects of microgravity on the human body

Materials

stopwatch or clock with a second hand
cm measuring tape
science journal

Background

When astronauts are in space, they experience the phenomenon known as "Puffy-Head, Bird-Leg" Syndrome. The astronauts feel a sensation of sinus stuffiness and develop puffiness in the face. Measurements taken before, during, and after space flight show that the legs do change their shape during space flight. Astronauts with larger leg circumference show a larger decrease in leg volume than astronauts with smaller legs. This change in shape makes sense because increased muscle requires more fluid and blood flow to feed that muscle. The more blood and fluid there is in one area, the more there is to move. The reported sensations in the head and the measured changes in the legs support the hypothesis that fluids in the body shift upwards during space flight.

Teacher Note: *Students who participate in this activity should be wearing pants or shorts.*

Procedure

1. Using a measuring tape, measure the circumference of your leg near the top of the thigh.
2. Record your measurement in your science journal.
3. Sit on the floor facing the wall.
4. Now put your feet up on the wall with your legs as flat against the wall as possible. See diagram.
5. As soon as you are settled, stay still and begin timing for 3 minutes.
6. At the end of 3 minutes, stand quickly and measure your leg again.
7. Be sure to measure at the same place on your leg each time.
8. Record your measurements.
9. Walk around the room several times or jog in place.
10. Measure your leg again.
11. Record this measurement.
12. Label the time each measurement was taken.

Diagram

Conclusion

1. What happened to the circumference of your leg after you had your feet up on the wall?
2. Why do you think this change happened?
3. How is this result similar to what the astronauts experience?
4. What happened to your legs after you resumed some physical activity?
5. What can astronauts do to overcome Puffy-Head, Bird-Leg Syndrome?

Extensions

Learn more about the effects of space on the human body. Go to the NASA web site and search for information about what happens to the astronauts in a microgravity environment. Find out what the astronauts do to compensate for these effects.

Boney Bones

Segment 2

Purpose

To learn the importance of calcium to bones and to investigate bone loss in microgravity environments

Materials

box of corn puff cereal
1 sandwich size, zip-locking plastic bag
calcium antacid tablets
coffee filters
magnifying lens
warm water
small bowl
spoon
measuring cup
science journal

Background

Bones are living tissue. On Earth, we need bones for support and protection. Calcium is a mineral that your body needs to help build healthy teeth and bones. Calcium keeps bones strong. Low levels of calcium pose a serious health risk, such as the increased chance of broken bones and fractures. Astronauts face many changes while in a microgravity environment. One of those changes is bone loss. On Earth, bones support the body's weight. However, in the microgravity environment of space, the stresses upon bones are reduced. The calcium in the bones begins to break down. As a result, the astronauts' bones begin to weaken. The excess calcium is then released into the bloodstream. The kidneys must filter the calcium rich blood, often causing kidney stones to develop. Bone loss appears to increase in proportion to mission length. An astronaut who has been in space for more than 180 days may lose 20% of his or her bone mass. When the astronauts return to Earth, they are at a higher risk of breaking bones because of the calcium loss. Exercise, diet, and in-flight rest can help counteract bone loss in space.

Procedure

1. Place 1 cup of cereal in the zip-locking plastic bag and seal.
2. Observe the cereal and record your observations in your science journal. The cereal represents the material of which bones are made, including calcium.
3. Slowly apply pressure to the cereal.
4. Observe and record your observations. What happened to the cereal?
5. The residue in the bag represents the calcium lost in space.
6. Measure 240 mL of warm water and pour it into a bowl.
7. Place 5 or 6 antacid tablets into the warm water and let dissolve. Note: To dissolve tablets more quickly, break them into smaller pieces. See diagram 1.
8. Observe and record your observations.
9. Use the spoon to help mix the tablets and the water.
10. Over a sink or outside, slowly pour the water through the coffee filter. See diagram 2.
11. Set the coffee filter in a safe place and allow it to dry.
12. Once the coffee filter is dry, use the magnifying lens to observe the surface of the coffee filter.

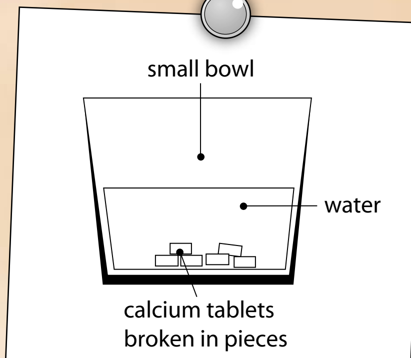


Diagram 1

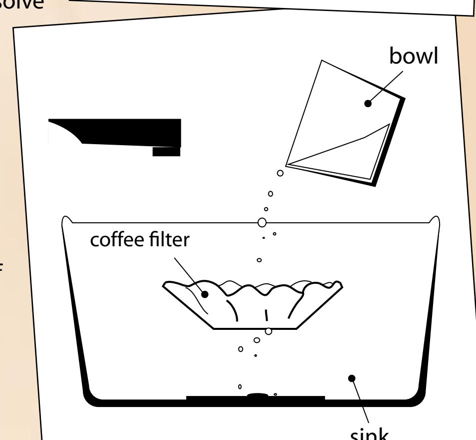


Diagram 2

Boney Bones

Segment 2

Conclusion

1. What is the residue on the coffee filter surface?
2. What does the coffee filter represent?
3. How does this experiment demonstrate what happens to the astronauts in space?
4. What can be done to prevent bone loss in space?

Extension

1. Visit the NASA Explores web site, ***http://www.nasaexplorers.com/show_k4_teacher_st.php?id=021223102504***. Complete the "Bendy Bones" activity to see how chemical changes can affect your bones.
2. Complete the NASA Explores activity "1,300 Milligrams a Day" found at ***http://www.nasaexplorers.com/show_k4_teacher_st.php?id=040409130625***. This activity demonstrates how much calcium we need per day.
3. Conduct research to find out more about calcium rich foods and a healthy diet. Present your findings to the class.

Basal Metabolic Rate and Calories*

Segment 2

Materials

Baseline Energy Needs worksheet p. 39
calculator
bathroom scale
measuring tape

Purpose

To determine Basal Metabolic Rate (BMR) and to calculate total energy needs

Background

All living things must get and use energy to live. Plants get their energy from the Sun in a process called photosynthesis. Human beings and other animals cannot process energy in the same way plants do. We must use a variety of food sources to meet our energy needs. The amount of energy stored in food is measured in calories. One calorie is the amount of energy needed to raise the temperature of 1 gram of pure water (or 1 mL) of water 1 degree Celsius. Most food labels are written with a capital "C," which represents a kilocalorie, the equivalent of 1,000 calories. A person's energy needs are based on gender, weight, height, and daily activities. Basal Metabolic Rate (BMR) stands for the number of Calories necessary to maintain life. This number is the baseline estimate of a person's energy needs when the body is resting. Your total energy needs depend on the type of activities you do and the time you spend doing them.

***Note**: Some of the numbers in the equation (to find the BMR) have been rounded for easier calculation.*

- For boys: BMR = 66.5 + (13.8 x W) + (5.0 x H) – (6.8 x Age)
- For girls: BMR = 655.1 + (9.5663 x W) + (1.9 x H) – (4.7 x Age)

W = actual weight in kilograms (1 kg = 2.2 lb)**

H = height in centimeters (2.54 cm = 1 in.)

Age = in years

** *Weight is not measured in kilograms, only mass. Weight is the amount of force acting on the mass. However, for simplicity, the term weight is used here.*

Procedure

1. Using the scale, obtain your weight in pounds.
2. Using your calculator, divide your weight in lb by 2.2 to give your weight in kg.
3. Record your weight in kg on the Baseline Energy Needs worksheet on page 39.
4. Using the measuring tape, obtain your height in cm. *(If a cm measurement is not available, divide your height in in. by 2.5 to give your height in cm).*
5. Record your height in cm on the Baseline Energy Needs worksheet.
6. Using the information from steps 2 and 4, complete the steps on the Baseline Energy Needs worksheet to get your own BMR.
7. Now that you know your BMR, let's find out your total energy needs.
8. In the Total Energy Needs chart, choose which energy level best suits your lifestyle *(low, medium, or high).*
9. Multiply your BMR by the number listed for your energy level.
10. Record your answer on the appropriate line next to your energy level.
11. You now know approximately what your daily caloric needs are.

* **This hands-on activity was adapted from activities in *From Outer Space to Inner Space/Food and Fitness: Activities Guide for Teachers* created by Baylor College of Medicine for the National Space Biomedical Research Institute under NASA Cooperative Agreement NCC 9-58. The activities used with permission of Baylor.**

• For additional activities visit *http://www.nsbri.org/Education/Elem_Act.html*

Basal Metabolic Rate and Calories*

Segment 2

Conclusion

1. Why is your BMR important?
2. What could a person do if he or she wanted to use more or fewer Calories in a day?
3. What would happen if you consumed more Calories than you actually need? Fewer Calories?
4. Why should astronauts worry about their BMR and total energy needs?

Extension

1. In your science journal, keep track of the amount of Calories you eat in a day. Compare that amount to the number of Calories you might consume in a day based on your total energy needs. Research foods that make a healthy diet. Plan a diet based on your specific total energy needs.
2. Find out about The President's Challenge: Active Lifestyle Program. This physical activity and fitness awards program is designed to motivate and reward students who work to become more physically active. Convince other people in your school to become involved. With the help of an adult, you can start your own physical fitness programs!

Basal Metabolic Rate and Calories*

Chart

Baseline Energy Needs

Weight = _______ lb ÷ 2.2 = ________ kg

Height = _______ in. ÷ 2.5 = _______ cm

Total Energy Needed

Resting energy needs, also called BMR, account for only some of the Calories used by the body. Physical activities also use energy. The total amount of energy used depends on the kind of activity and time spent working on it.
Use the BMR you calculated to find out how many Calories you might actually use each day.

BOY	GIRL
______ kg x 13.8 = ______ (A)	______ kg x 9.6 = ______ (A)
______ cm x 5 = ______ (B)	______ cm x 5 = ______ (B)
______ (A) + ____ (B) = ______ (C)	______ (A) + ____ (B) = ______ (C)
______ (C) + 66.5 = ______ (D)	______ (C) + 655.1 = ______ (D)
______ (Age) x 6.8 = ______ (E)	______ (Age) x 4.7 = ______ (E)
______ (D) - ____ (E) = ______ (BMR)	______ (D) - ____ (E) = ______ (BMR)

Select the category that best describes the exercise level for you and solve the corresponding equation that follows. You also will need your BMR number from the Baseline Energy Needs worksheet.

- **Low Energy:** Most strenuous activities in a day include at least an hour of one of the following: reading, sitting, or eating.

  Equation: 1.3 x BMR = ______Cal/Day

- **Medium Energy:** Most strenuous activities in a day include at least an hour of the following: walking, dancing, skating, bowling, golfing, or other light exercise.

  Equation: 1.7 x BMR = ______Cal/Day

- **High Energy:** Most strenuous activities in a day include at least one hour of one of the following: running, bicycling, playing basketball, playing soccer, gymnastics, playing tennis, or other moderate to intense exercise.

  Equation: 1.9 x BMR = ______Cal/Day

A Little Dry Around the Edges

Segment 2

Materials

dehydrated foods (dehydrated bananas, figs, beef jerky, apple chips, fruit, instant pudding, powdered drink mix, dehydrated ice cream)
plastic sandwich bags
straws
scissors
water
science journal

Purpose

To demonstrate food dehydration

Background

The food NASA astronauts eat in space is very similar to the food you can find at a grocery store. Astronauts may choose their menus from a standard menu, or they may substitute food choices of their own provided they meet nutritional guidelines. Dietitians check the astronaut's menus to ensure they are balanced and nutritional. Weight and volume are problems for anything launched into space. Food is no different. Weight allowed for food is limited to 1.7 kg per person per day, including the packaging, which weighs 0.45 kg. All food is either eaten fresh or precooked and needs no refrigeration. Precooked food is ready to eat by heating it or adding water to it. Water is added to foods that have been dehydrated. Dehydration is one method of preparing food for space. Dehydrated food has had the water it contains removed. To rehydrate these foods, water or saliva can be added.

Note: *Dehydrated ice cream has separate instructions to rehydrate. Check the package for the correct method.*

Procedure

1. Examine the dehydrated food.
2. In your science journal, describe the food with words and pictures.
3. Some dehydrated food can be rehydrated with just the saliva from the mouth.
4. Rehydrate the bananas, apple chips, fruit, figs, and beef jerky in your mouth. Pay attention to the way the food feels and tastes as it rehydrates.
5. Record your observations in your science journal.
6. Some dehydrated food must be rehydrated by adding water.
7. Place the instant pudding in a plastic bag. Put the powdered drink mix in another bag.
8. Taste a small amount of the dehydrated instant pudding and powdered drink mix.
9. Add a small amount of water to each bag.
10. Now taste the rehydrated food.
11. Record your observations in your science journal.

Conclusion

1. Why do astronauts use dehydrated food?
2. What are some other uses of dehydrated food other than food for space travel?
3. What other kinds of dehydrated foods can you think of?
4. Explain why some dehydrated foods can be rehydrated by mouth and others must be rehydrated with water?

Extension

Dehydrate some foods on your own. Place various types of fruit in the sun (i.e., grapes, plums, apricots). Record what happens in your science journal.

Find the space grocery list online. Visit your grocery store to see how many items you can find. Why do you think some of the products on the list were chosen?

Eating Healthy in Space*

Segment 2

Problem

To plan a menu for an astronaut by using caloric values, serving sizes, and food groups

Optional Web Sites

NASA: National Space Biomedical Research Institute

Go to this web site to download a PDF copy of Food and Fitness and use pages 18–19 to find the caloric value of various foods.

http://www.nsbri.org/Education/Elem_Act.html

Mike's Calorie and Fat Gram Chart for 1000 Foods

At this web site, foods are listed alphabetically for easy use.

http://www.caloriecountercharts.com/chart1a.htm

Calorie Counter Database

Visit this web site to search by food categories and find your favorite brand name foods with nutritional information.

http://www.calorie-count.com/

Caloriesperhour.com: Food Calories and Nutrition Calculator

Visit this web site to find the caloric value of food as well as the number of calories you burn while doing various activities. If you enter your height, weight, and age, you can even calculate your body mass index (BMI), basal metabolic rate (BMR), and resting metabolic rate (RMR). This site also provides a sample of what you can eat to burn the number of calories in each activity. *http://www.caloriesperhour.com/index_food.html*

Kids' Health—For Kids: The Food Guide Pyramid

Visit this great web site for kids to learn about the food pyramid and serving sizes. *http://kidshealth.org/kid/stay_healthy/food/pyramid.html*

Food and Nutritional Information Center: Food Guide Pyramid

Check out this site to view or download a copy of the Food Guide Pyramid booklet produced by the US Department of Agriculture (USDA). The booklet is also available in Spanish. *http://www.nal.usda.gov/fnic/Fpyr/pyramid.html*

Materials

(per group)

- assortment of different size needles
- thread
- 1 large cup
- 1 small cup
- water
- paper towels
- soft ball
- science journal
- blindfold (optional)

* **This hands-on activity was adapted from activities in *From Outer Space to Inner Space/Food and Fitness: Activities Guide for Teachers* created by Baylor College of Medicine for the National Space Biomedical Research Institute under NASA Cooperative Agreement NCC 9-58. The activities used with permission of Baylor. All rights reserved.**

- **For additional activities visit *http://www.nsbri.org/Education/Elem_Act.html***

Procedure

Part 1. Planning a Menu

1. Using your current knowledge, discuss in your group what constitutes a healthy diet for an astronaut. Be sure to discuss the number of calories, nutrition needs (food groups), portion sizes, and variety.
2. Use the Menu Planner to plan a 3-day menu for an astronaut.
3. Use a calorie counter book or web site to determine the number of calories for each food and record the daily total at the bottom of the Menu Planner.
4. Use a food pyramid to determine the food group(s) for each food and record the total for each food group at the bottom of the Menu Planner on page 44.

Eating Healthy in Space*

Segment 2

5. Discuss in your group and decide whether your 3-day menu plan is healthy and sufficient for an astronaut.
6. Share your menu with the class and discuss the pros and cons of your menu plan.

Part 2. Serving Size

Food labels and other guides often use "serving size" to describe a recommended single portion of food. Serving sizes are different for various foods (liquid versus solid foods and cooked versus raw foods). In many cases, the amount specified as a "serving size" for a particular food is smaller than the amount typically eaten. Food portions frequently are measured in terms of cups, pieces, ounces, and other units.

1. Using the Menu Planner, write down everything you had to eat yesterday.
2. Use a calorie counter book to help determine the serving size of each food. For example, one serving (portion) is equal to either 1 slice of bread, 2 tablespoons of peanut butter, 1 tablespoon of jelly, about 15 potato chips (1 oz), or 1 cup of milk. If you ate a peanut butter and jelly sandwich with a bag of chips and a glass of milk, you probably consumed 2 servings of bread, 1–3 servings of peanut butter, 1–4 servings of jelly, 1–2 servings of chips, and 1–2 servings of milk.
3. Were serving sizes different from what you perceived as a single serving? Discuss and record the similarities and differences.
4. Often, the serving sizes listed on the labels of food packages are larger than the serving sizes listed by other guides, such as the Food Pyramid. Look at the Nutrition Facts on various labels and compare the serving sizes listed in other guides. Discuss how they differ and why.

Part 3. Calorie Counting

Our bodies constantly use energy. Food provides us with the energy we need for our daily activities. The amount of energy stored in food is usually measured in calories; however, to maintain an appropriate weight, we must balance the foods we eat with the energy we spend. Calorie intake must match calorie expenditure. When the body takes in too many calories, part of the excess is stored as fat. Conversely, when more calories are used than are consumed, stored fat is burned to make up the energy difference.

1. Using the portion size determined for each food listed in Part 2, determine the number of calories consumed for the day.
2. An average, moderately active 7 to 10 year old needs about 2,000 calories per day. Did your diet have more or fewer calories than the average needed?

Eating Healthy in Space*

Segment 2

Part 4. Nutritional Needs

The Food Pyramid helps you choose a healthy diet by recommending the number of servings you should eat daily from each of the six food groups. Be careful and don't be fooled by serving sizes. The serving sizes may be different from the ones on nutrition facts labels. For a balanced diet, it is not only important to eat the correct number of calories, it is also important to eat a variety of foods so that you get all the nutrients you need to maintain a healthy body. Here are some general guidelines for a healthier diet. Choose the following whenever possible:

1. Use the Food Pyramid Guide (page 45) and a food pyramid resource to determine the food groups consumed in your diet (listed in part 2). Be sure to list a group twice or more if you ate more than one serving of the food. For example, a large bagel is about 3.5 servings, so it would be about 3.5 servings of wheat and grains.
2. Tally the number of servings in each food group and record.
3. Discuss whether your diet was a "balanced" diet.

Part 5. Evaluate and Correct

It is important to remember that everyone has unique nutritional and health care needs. However, for this exercise, it has been determined that an average astronaut needs about 3,000 calories per day.

1. Using what you have learned about serving size, calories, and food groups, carefully evaluate the 3-day menu you planned for an astronaut in Part 1.
2. Make any necessary changes to your menu to create a well-balanced diet with the proper number of daily calories.
3. Share your menu with the class and discuss.

Conclusion

1. What other factors should be considered when planning a menu?
2. Was it difficult to balance calories and nutrition? Why or why not?

Extensions

1. Look up the number of calories for small, large, and super size orders of French fries from your favorite fast food restaurant. Discuss the disadvantages to "super-sizing" your fries.
2. Visit the web sites of various fast food restaurants and determine which foods on the menu are the healthiest choices.
3. Discuss how you can improve your diet by making better choices.

Eating Healthy in Space*

Menu Planner

DAY / DATE

Water: Eight cups (8-oz glasses) per day

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

TIME	FOOD ITEM & AMOUNT *(List major ingredients for prepared foods.)*	CALORIES	FOOD GROUP: Breads Br	Vegetables Ve	Fruit Fr	Meats Me	Milk Mi	Fats Fa

Physical Activity

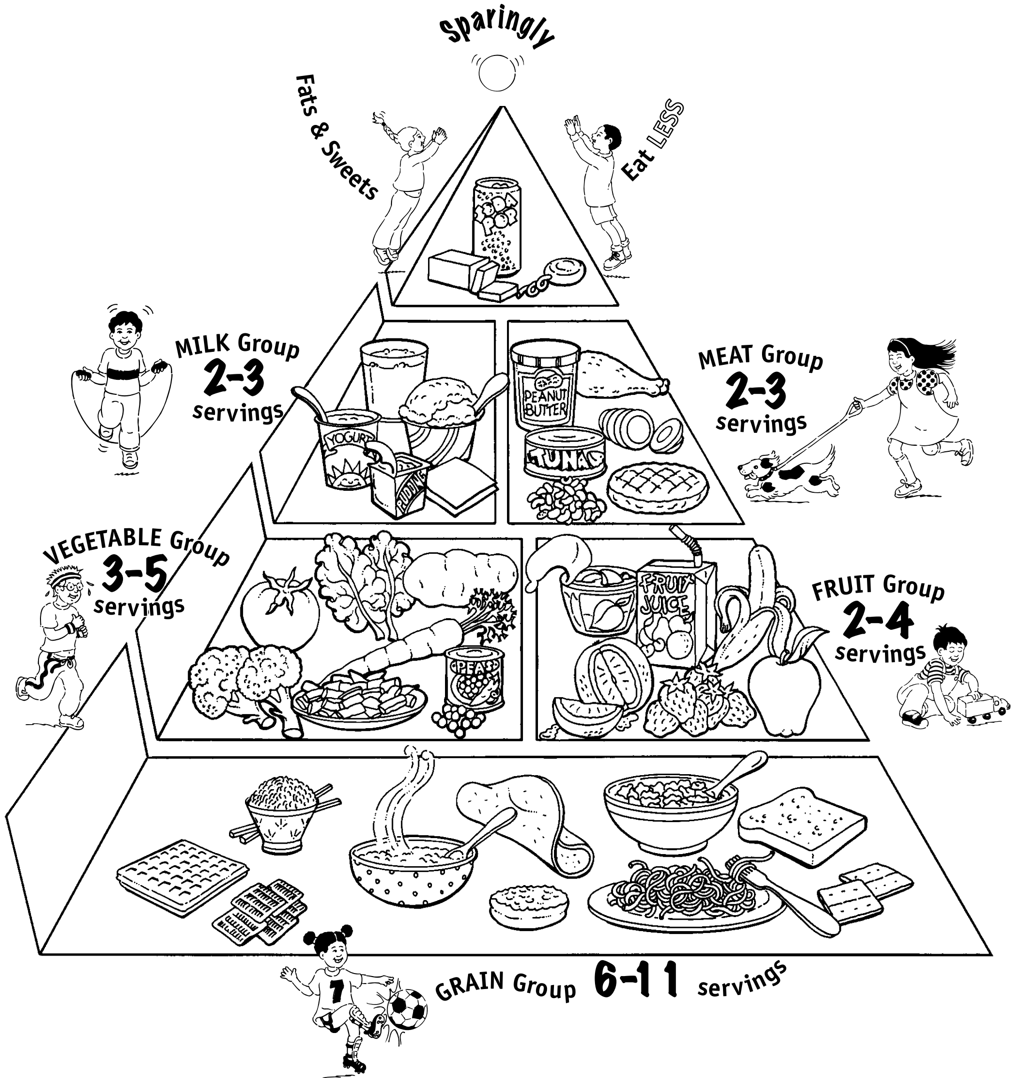
DAILY TOTALS

Calories ____________

Br	Ve	Fr	Me	Mi	Fa

Eating Healthy in Space*

Food Pyramid Guide



Note: The Food Pyramid is changing in 2005.
http://www.nal.usda.gov/fnic/fpyr/pyramid.html

Eating Healthy in Space*

Labels & Estimates

Serving sizes often are smaller than the portions we actually eat.

Look for low levels of saturated, hydrogenated, and trans fats. They are unhealthy.

Cholesterol is found in foods of animal origin.

Look for foods that have more carbohydrates as fiber and fewer as sugar. Only foods from plants provide fiber.

Protein is important for muscles and growth. It is found in animal and plant foods.

Vitamins and minerals are essential for health. Calcium is important for bones and teeth.

Use this section as a guide for daily planning. The amount of calories needed by each person depends on many factors, including exercise.

Refried Beans Fat Free

Nutrition Facts

Serving Size 1/2 cup (125g)
Serving Per Container 3.5

Amount Per Serving

Calories 130 Calories from Fat 0

	% Daily Value*
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 490mg	**20%**
Total Carbohydrate 24g	**8%**
Dietary Fiber 7g	**28%**
Sugars 0g	
Protein 9g	**16%**
Vitamin A	**0%**
Vitamin C	**0%**
Calcium	**6%**
Iron	**15%**

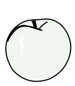
* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

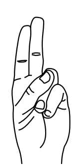
	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Use the Quick Hand Measures to estimate the size of one serving of different foods.

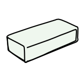
Quick Hand Measures

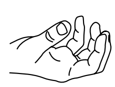
A closed fist = Piece of fruit or cup of raw vegetables



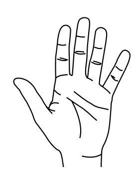


Two fingers = Ounce of cheese



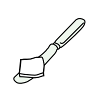


A cupped hand = Cup of dry cereal



An open hand = Single serving of meat

Tip of thumb = Teaspoon of butter



Are Two Eyes Better Than One?

Segment 2

Purpose

To understand the benefits of stereoscopic vision

Background

People have two eyes positioned side by side. Each eye takes a view of the same area but from a slightly different angle. The two images are sent to the brain where the similarities are combined and the small differences are added in. All this information combined creates the final image we actually "see" and is called stereoscopic vision. With stereoscopic vision, we can more accurately see the position of objects in relation to our bodies. Robots that explore other planets must be able to see where they are going. Just like people, robots make good use of two eyes. Why are two eyes so much better than one?

Materials

(per group)

assortment of different size needles
thread
1 large cup
1 small cup
water
paper towels
soft ball
science journal
blindfold (optional)

Procedure

1. Cover or shut one eye.
2. Try to thread a needle.
3. With one eye still closed, try to thread a bigger needle.
4. Now try to thread the same needles with both eyes open.
5. Was there a difference?
6. Write or draw in your science journal what happened.
7. Cover or shut one eye.
8. Try to pour water from the large cup into the smaller cup.
9. Now try to pour the water from the large cup into the smaller cup with both eyes open.
10. Was there a difference?
11. Write or draw in your science journal what happened.
12. Clean up any spilled water with the paper towels.
13. In a small group, stand in a circle.
14. Have every person cover or shut one eye.
15. Toss a ball that is soft around the circle.
16. Make sure every person has a chance to participate.
17. Now do the same thing with both eyes open.
18. Was there a difference?
19. Write or draw in your science journal what happened.
20. Focus on one object in the room.
21. Cover or shut one eye.
22. Hold up your thumb and line it up so that it covers the object completely.
23. Still holding your thumb up, open the closed eye and cover or shut the other eye.
24. In your science journal, write or draw what happened.

Are Two Eyes Better Than One?

Segment 2

Conclusion

1. Why was it challenging to do some of the previous activities with one eye closed?
2. What would happen if your eyes were spaced farther apart? Would you still be able to see the same way?
3. Why is it important for the Mars rovers to have stereoscopic vision?

Extension

Not all animals have stereoscopic vision. Some animals have monocular vision. Conduct research to find out more about monocular vision. Find out which types of animals have stereoscopic vision and which ones have monocular vision. Make a Venn diagram to compare and contrast stereoscopic and monocular vision.

Red Rover, Red Rover

Segment 2

Purpose

To explore the challenges faced by scientists and engineers operating rovers and to understand the importance of stereoscopic vision

Materials

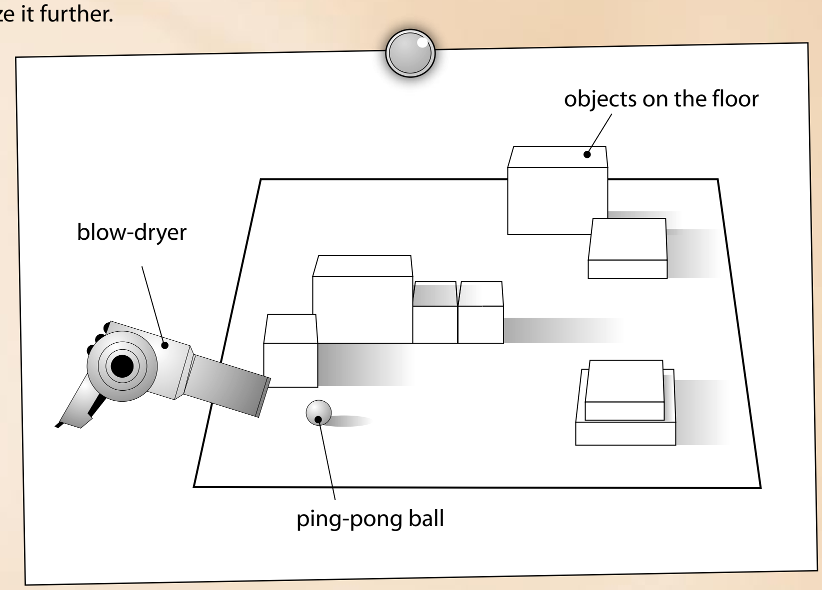
ping-pong ball
different sized objects to make obstacles (blocks, cans, books)
science journal
blow-dryer
blindfold (optional)

Background

A rover is a remotely operated vehicle built mostly for use on unmanned missions. A rover can go to places human beings can't due to the harshness of space, distance, or possible threats to people (e.g., radiation and extreme temperatures). Rovers scan the ground, move toward a selected item such as a rock, collect information, and send that information back to scientists here on Earth. Just like human beings, rovers have "eyes," an arm, mobility, and the ability to communicate. Because of the large distances from Earth to the rover's location, scientists cannot communicate with the rover in real time. The rovers communicate with Earth only a few times a day. Scientists are looking for places of interest, so they use the rover's cameras to decide where to send the rover. In the morning, the rover receives destination coordinates but is not told how to reach the destination. The rovers must use their "brain" (computer software) and "eyes" (stereoscopic cameras) to navigate to the correct destination. Navigating on another planet hundreds of millions of miles away is an incredible challenge. The surface might have hazards such as deep canyons, volcanic mountains, craters, boulders, or sand dunes. The "brain" of the rover is programmed with a given set of responses. When the rover encounters a hazard or an obstacle, it must "think" of how best to maneuver around the area. The stereoscopic cameras are essential for proper navigation. They give the rover the ability to judge distances and to maneuver around or over obstacles. Once the rover arrives at its destination, it samples the soil and rocks around the site. At the end of the day, scientists on Earth download the information the rover has collected to analyze it further.

Procedure

1. Arrange your obstacles in various locations on the floor.
2. Some obstacles can be stacked upon each other.
3. Place the ping-pong ball near the obstacles.
4. With adult supervision, use the blow-dryer to blow the ball towards the obstacles.
5. Try to make the ball go over the obstacles.
6. Record in your science journal what happened.
7. Close one eye or cover it with a blindfold.
8. Try to make the ball go over the obstacles.
9. Record what happened.
10. Close both eyes.
11. Have a partner give you directions to help you maneuver the ball over the obstacles and record what happened.
12. Arrange the objects to make a maze.



Red Rover, Red Rover

Segment 2

13. Using both eyes, try to maneuver the ball through the maze by using the blow-dryer and record what happened.
14. Close one eye and try to make the ball go through the maze. Record what happened.
15. Close both eyes and have a partner give you directions to help you maneuver the ball through the maze. Record what happened.

Conclusion

1. Was it better to have one eye, two eyes, or no eyes to maneuver the ball over the obstacles and through the maze? Why?
2. What would make it easier to maneuver the ball over the obstacles and through the maze?
3. What challenges might engineers face in sending a rover to another planet?

Extension

1. Create your own rover. Purchase a remote control model, build it, and try to maneuver it over the same obstacles and through the same maze. Was the result the same as with the ping-pong ball? Record your findings in your science journal.

2. Visit the NASAexplores web site and complete the activity, "Commanding a Robot." Why is communication such an important part of the command process?

   http://www.nasaexplorers.com/show_58_teacher_st.php?id=030109160421

Answer Key

Segment 2

Puffy-Head, Bird-Leg Syndrome

1. The circumference became larger.
2. Students answers will vary but should include remarks about the fluid in the legs moving downward toward the floor.
3. When the astronauts move or work in microgravity, the fluid in the lower part of their bodies moves upwards without the aid of gravity to maintain normal flow.
4. Your legs return to normal size.
5. Astronauts must do specific exercises and continue to physically move around while in microgravity to lessen the effects.

Boney Bones

1. The residue on the coffee filter is calcium.
2. The coffee filter represents the kidney.
3. Microgravity affects human bones by breaking down the calcium in the bones. This excess calcium is released into the bloodstream. The kidneys must then filter the calcium from the blood. Excess calcium hardens in the kidney ducts and becomes kidney stones.
4. Exercise, diet, and adequate in-flight rest help overcome this problem.

Basal Metabolic Rate and Calories

1. The BMR tells you how much energy the body requires to function when it is at rest.
2. A person should increase activity levels to increase the number of Calories used in a day or reduce activity levels to decrease the number of Calories needed in a day.
3. When a person consumes more Calories than the body uses, the leftover energy is converted to fats and stored in the body. A person may be sick or even die if the body does not take in enough Calories to maintain its vital functions for an extended period of time.
4. Astronauts want to be in the best possible physical condition to stay alert, complete their jobs, and return home safely. Understanding more about their own BMRs will help them plan and implement a diet that meets the needs of their bodies in the harsh microgravity environment.

A Little Dry Around the Edges

1. Dehydrated foods do not require refrigeration to avoid spoiling and weigh less because they have little or no water content.
2. People take dehydrated foods on camping trips. Soldiers use these foods for survival packs. Some dehydrated foods are healthy snacks. (Additional answers may vary.)
3. Answers will vary.
4. Whether the food can be rehydrated in the mouth or by using water depends on the amount of liquid required to rehydrate it.

Eating Healthy in Space

1. Answers will vary.
2. Answers will vary.

Are Two Eyes Better Than One?

1. If your brain is getting information from only one eye, you have no depth perception. One eye is better than none and you would need very good directions if you had no eyes.
2. Although peripheral vision would improve, a blind spot would develop between the eyes.
3. The rover can better maneuver over and around obstacles when it is using stereoscopic vision. The rover is able to determine distance from objects as well.

Red Rover, Red Rover

1. Two eyes give you more information about your surroundings.
2. Answers will vary.
3. The surface of the planet may be uneven, covered with rocks or debris, have canyons, mountains, craters, or sand dunes. Most of the terrain explored by the Rover is unknown territory that has never before been seen or mapped.

On the Web

Sources of Energy

1. Since 1 calorie is needed to raise 1 mL of water 1 °C, 50 calories would be needed to raise the temperature of 50 mL of water.
2. Answers will vary.
3. Answers will vary. (Whichever food yielded the most calories will provide the most energy.)
4. When the body digests food, enzymes in the digestive system release the energy in the foods. This process is similar to what occurs when the food is burned with the flame.
5. Foods that contain more potential or stored energy provide larger amounts of calories when they are burned in the body.

3-D and Me

1. Answers will vary but might include that the pictures looked fuzzy and that there are lines of blue and red in the pictures. Answers will vary but might include that after the glasses were put on, the picture looked more real and had depth to it.
2. Answers will vary, but might include that rovers need the depth perception provided by 3-D vision to more easily maneuver on a planet and avoid obstacles.